INFORMATICS FOR DEVELOPMENT

The New Challenge

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The New Challenge

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ABBREVIATIONS AND ACRONYMS

AFTN	Aeronautical fixed telecommunication network
APT	Automatic picture transmission
ASCII	American Standard Code for Information Interchange
ASIC	Application-specific integrated circuit
ATM	Automatic teller machine
BPS	Bits per second
CAB	Computer-assisted banking
CAD	Computer-assisted design
CAI	Computer-assisted instruction
CAM	Computer assisted manufacture
CATV	Cable television
CD/ROM	Compact disk read only memory
CIM	Computer-integrated manufacturing
CMMS	Computer management and maintenance system
CMOS	Complementary metal oxide semiconductor
CPU	Central processing unit
DDP	Distributed data processing
EDI	Electronic data interchange
ELPM	Electronic ledger posting machine
ELSI	Extra large-scale integration
EPABX	Electronic private automatic branch exchange
GATT	General Agreement on Tariffs and Trade
GIS	Geographical information system
IDD	International direct dialing
IDN	Integrated digital network
ISDN	Integrated services $di_g it_a l$ network
ISDS	International Serials Data System
ISO	International Organization for Standardization
IT	Information technology
ITM	Informatics tools and methods
ITU	International Telecommunications Union KBKilobytes
KBPS	Kilobytes per second
LAN	Local area network
LCT	Low-cost satellite communication terminal
LSI	Large-scale integration
MAN	Metropolitan area network
MICR	Magnetic ink character recognition
MIS	Management information system
MOS	Marine observation satellite
MOS	Metal oxide semiconductor
MTN	Main telecommunication network
NMOS	N-channel metal oxide semiconductor
ODETTE in Europe	Organization for Data Exchange by Tele Transmission
OECD Development	Organization for Economic Cooperation and
PBX	Private branch exchange
PC	IBM-compatible personal computer
PC-AT	Personal computer advanced technology
PCM public data network	Plug-compatible manufacturer PSDN/PSPDN Packet-switched
RAX	Rural automatic exchange
RLDC	Regional load dispatch center
RTH	Regional telecommunication hub

SNA	Systems network architecture
STD	Subscriber trunk dialing
SWIFT	Society for Worldwide Interbrain Financial Telecommunications
TCDC	Technical cooperation among developing countries
TDMA	Time division multiple access
TNC	Transnational corporation
TPD	Tonnes per day
UHF	Ultra-high frequency
UNDP	United Nations Development Programme
UNIFSTD	United Nations International Fund for Science and Technology for Developing Nations
VCR	Video cassette recorder
VDU	Video display unit
VHF	Very high frequency
VLSI	Very large-scale integration
WMO	World Meteorological Organization

FOREWORD

Saburo Okira

Given the fact that information technology is evolving at a rapid pace in the industrialized countries, debate at the second session of the North South Roundtable on the Informatics Revolution centered on the question of what impact this will have on development in the Third World countries, and what can be done to ensure that this impact is beneficial.

Three working sessions of this meeting focused respectively on policy issues from the developed countries' point of view, from the developing countries' point of view, and priorities for international collaboration. During the sessions, co-chaired by myself and Maurice F. Strong of Canada, a number of vital issues related to information technology were addressed, including the possibilities that competition may develop between the developing countries' laborers and the developed countries' robots in the production sphere, and that the gap between the North and South may widen, with information and knowledge becoming even more concentrated in the industrialized countries. There was a lively exchange of opinions on such issues as finding ways to make use of the large numbers of people in the developing countries who are talented in the software field and the question of what kinds of technology are most effective for promoting social and economic development.

The potential influence of information technology on international relations and international economics, as well as domestic political and social structures, was identified as a prime subject for cooperative studies by the industrialized and developing countries. Noting that information is no respecter of national boundaries, M.D. Kirby, President of the Australian Court of Appeal, said that information technology was one of the prime forces behind General Secretary Gorbachev's reforms in the Soviet Union.

While Japan must concentrate its efforts on creating a more sophisticated industrial structure, it also has a responsibility, as an industrialized country, to study the impact that the information revolution will have worldwide and to seek to develop technologies appropriate for the developing countries. Areas of international collaboration proposed in the Tokyo Statement issued at the close of this Roundtable included (i) building up an international telecommunications infrastructure, (ii) developing domestic capabilities in software development and hardware maintenance, (iii) disseminating information on new information technologies, standards and uses. (iv) improving the developing countries' access to informatics technology, and (v) assisting in training programs.

I would like to express my gratitude to the following organizations for the help they offered in holding this conference: the Japanese government, the Tokyo chapter of the Society for International Development, Fujitsu Ltd., Hitachi Ltd., Hoso-Bunka Foundation, IBM Japan Ltd., Kokusai Denshln Denwa Company Ltd., Mitsubishi Electric Ltd., NEC Corporation, Nippon Telephone and Telegraph Corporation, Nippon Unlvac Kaisha Ltd., Oki Electric Industry Company Ltd. and the Toshiba Corporation.

PART I
AN OVERVIEW

CHAPTER 1

Informatics for Development: Policy Issues

Khadija Haq

The informatics revolution - the term we use for dramatic strides in high technology in the field of computers and communications - is bringing about such revolutionary changes in organizational, social and political structures that no nation, large or small, developed or developing, can remain unaffected by this grand sweep. Like its predecessors, the agricultural and the industrial revolutions, this one too has the potential to be used for either good or evil -to inform, educate and foster progress or to coerce, disinform and suppress progress.

For the developing countries, the crucial question is not whether to adopt information technology, but how to harness it for the betterment of their vast numbers of poor people. Developing countries need to plan carefully and consciously to ensure that the adoption of this technology does not end up widening the gap between the rich and the poor.

The informatics revolution is fed by technological breakthroughs in computer hardware and software, in mini and microcomputers and processors, in laser and fiber optics, in satellite communication, in digitalization in communication, and in artificial intelligence. The marriage between the high speed and large volume of data processing capabilities of modern computers and the transmission capacities of modern telecommunications and satellites is transforming the world into a global network, intertwined and intertiked across national boundaries. At both the global and national levels, the technological frontiers are being pushed forward faster than the institutional arrangements to manage them. At the international level, issues such as how to protect intellectual property when ideas can move instantaneously across frontiers can be just as vexing as nationaldevel issues such as how to safeguard the confidentiality and security of data against security breaches or the

Many of the ideas contained in this paper were first ducidated by participants in the Tokyo Round, to whom the author is indebted. Views presented herein,however,are the authors own.

injection of computer 'viruses" by independent programmers.

There are strong economic and social imperatives for the developing countries to adopt information technology. Whether we like it or not, the informatics revolution is already changing the relative competitiveness of developed and developing countries in the production of goods and services. New technologies such as office and factory automation, flexible manufacturing systems, intercontinental real time and interactive communication are posing serious questions for the old theory of comparative advantage. The developing countries can no longer depend on their low

labor cost to industrialize, and their labor will be increasingly competing against high-speed robots.

The economics of this change in competitiveness calls for a reconsideration of approaches and strategies for industrialization of the less developed countries. The new technologies are opening up possibilities for developing countries to enter into new categories of manufacturing which do not require large-scale investment in heavy equipment and infrastructure. Miniaturization, and the consequent reduction of material and energy consumption, are widening the options for developing countries. Certain new manufacturing industries, such as the production and packaging of microprocessor chips, are compelling new investment items.

In the coming decades, the engine of growth is going to be driven by the twin components of information technology-cony peters and communications. Thus, from a long-term perspective, the development and application of this technology will be the key to the economic viability and competitiveness of the developing countries, as it will have profound implications for education and training, mass communication, industrial productivity and the quality of life.

Impact of the Informatics Revolution

The impact of the informatics revolution on social, economic and cultural life in developing countries is now being widely debated by social scientists. It will be prudent for each country to anticipate social and cultural consequences early in order to minimize unforeseen negative developments.

First is the issue of employment. Production is being automated in the primary and secondary industries, while office automation is
the trend in the secondary and tertiary industries. This is expected to reduce labor requvements in these sectors, which could pose serious social problems. On the other hand, new software and service industries within the tertiary sector are expected to generate new employment opportunities.

Second, the informatics revolution could increase the economic gap between the rich and poor nations - or it could make developing-country economies more active, improve their quahty of life, create new wealth through increased productivity, and eventually narrow the economic gap.

Third, and on the positive side, with computers and telecommunications introducing voice data, images, etc. across national frontiers, the concept of nafionai boundaries will change. The volume of information Flow will increase, increasing people's access to information at home and at work, within and outside the country of nrigin. As such, the world will eventually become a truly global community. But in order for this to happen, nations have to agree on:

a) The free flow of data internationally.
b) The elimination of monopolies to ensure free and fair competition.
c) Affirmation of the principle that the benefits oC the
informatics revolution must be shared by all.

Finally, the social impact of the new information technologies is going to be more profound than that of classical information technologies. Because they are light, flexible and user-friendly, the new technologies are penetrating daily life at a (aster pace, changing behaviors and organizational s[mctures. Some functions, such as those performed by office secretaries and switchboard operators, are disappearing. Changes are occurring in the geographical location of jobs. The speed of infomration transmission is increasing as mail is replaced by electronic message transmission. Policy Issues The informatics revolution has origjnated in societies which are saturated in capital accumulated during Lhe first two revolutions. The informatics revolution is the product of that accumulated capital applied in order to better manage and augment that capital through the service sector. Viewed from this perspective, the informatics
revolution raises different policy issues for developed and developing countries. Whereas the preoccupations of the developed countries are the rapid technological changes in this field, access to and diffusion of new technologies, the shift in technological preeminence Crom the U.S. and Western Europe to Japan (and the resultant potenfial shifting of economic *power),* and the implications for international trade and cooperation, Che developing countries' concerns cover a much wider range of issues, from social, pouttoai and ethical questions to

infrastmctural, institutional and human resource development priorities. The issues that constantly arise in policy debates are:

a) Does the country have an adequate infrastructure for the effecflve application of information technology?

b) Should a country enter into the production of informatics products? When, and in what direction?

c) Does the Country have sufficient trained manpower to apply the technology?

d1 What are the employment implications of the introduction of informatics teehnolo~es?

z) How can the transfer of technology between developed and developing countries and among developing countries be best accomplished?

A key impediment to the introduction of informatics is the inadequacy of infrastructure in many developing eauntries. This ranges from inadequate and/or unreliable electric power supplies to insufficient institutional mechanisms and procedures to manage and provide services. The lack of an adequate nationwide telecommunications network is a particularly crippling handicap, as eommunication is an integral part of informatics. Yet for most developing eounhies, this handicap is unnecessary, as technolo®eaf products in this area have come down in cost and have become relatively easy to acquire, install and maintain. The planned development, disVibudon and maintenance of nationwide telecommunications facilities and electricity supplies, and building the institutions to support these, must be key elements in any informatics strategy that a govetnmenC wants to pursue. For those developing countries which have vast inaccessible areas and insufficient telephane lines, nonvoice telecommunication facilities (via satellite) might be an optiat wltich needs to be seriously considered.

The crucial policy decision regarding whether developing countries should manufachtre or purchase informatics products depends on each country's stage of development. The size of the country, the character and composition of its economic sectors, levels of physical and institutional infrastructure, and levels of education and tmining all enter into the decision of when to engage in production and what to produce. However, it is possible for even small developing countries to produce computer parts. Many countries are opting to produce software, as this requires less capital than producing hardware, and it can be produced in local languages and in accord with local needs. Although some large manufacturers have undertaken to adapt their software to developing-country contexts and translate it into local languages, each country must try to encourage a policy of using locally (mined professionals to produce their own software. Of course, to produce software, one needs not only highly [mined professionals, but also the availability of some hardware.

The availability of sufficiently [mined manpower is another essential element in a country's decision to adopt information technology. For smaller countries, the question is not whether to make or buy the equipment, but to what extent to train professionals in the computer and teleeommurdcations fields and in methodoloAes for planning, design and implementation of these technology applications. The goal should be to spur the externalization process, i.e., the development of a wide range of professional and support services that can enhance the competitive positioning of a country's economy and its quality of life. Whether to offer tmining within the country, the re®on or in developed counMes depends ou mining needs and country objectives. One attendant risk of foreign training is the notorious "brain drain" that has plagued developing countries when they send their nationals abroad.

The employment-reducing aspect of the introduction of information technology must be anticipated and planned for. It is important to distinguish between the impact at the micro or enterprise level, where employment might be adversely affected, and the impact at the macro or country level, where the introduction of this technology might open *up new* avenues for employment in other sectors. Whenever there is technological change, it leads to some structural imbalances, necessitating structural adjustments. If

we take a static view of the impact which results from the introduction of information tedmology. then of course it (cads to unemployment in certain sectors. Huwcver, in [he context of [he overall economy.
information technology can fuel growth and hence create the potential for more jobs, for which policy makers should be ready and people trained.
Huge amounts of physical, financial and human resources are being used in developedoountry laboratories for information technology research and development. Apart from those high-tech products and technologies which are barzed from entering the intemadonal market (or national security reasons, the developed countries should transfer market-oriented products and technoogies to developing countries (especially those countries which cannot afford to spend on local R&D) in their enlightened self-interest to expand markets and to assist these countries in their development If is ironic that technology is often more easily transferred to those developing countries which already have their own highly developed R&D sectors, while it is denied to smaller, poorer countries which lack bargaining power.
Thus the important points that policy makers need to recognize
before embarking on a policy of introducing informatics in a devel
oping society can be summed up as follows:
a) The potential of informatics technology to facilitate economic and social development and to strengthen international links needs to be recognized.
b) The diverse nature of developing countries requires that stategies to introduce informatics technology into their societies be different from one country to another.
c) An inventory of existing physical, financial and human resources needs to be prepared and future requirements assessed and planned (or.
d) The enormous potential of this technology to develop human resources through education and training and to enhance management capabilities needs to be harnessed.
A National Informatics Policy

For orderly, costcffective and technologically compatible app0cations of informatics in a country, the Cormutation of a broad national informatics policy is essentiah The main elements of such a policy might include fi) selection of priority sectors for theapplication of information technology (u) identification of infrastructural requirements for effective application of the technology in these priority sectors; (iii) preparing plans and formulating wncrete strategies to implement policy; and (iv) suggesting measures to evaluate the impact of policy on productivity human resource budding, employment and the sociocultural environment.
An informatics policy has to be backed up by necessary legislation and regulations in order to protect the country and the consumer, In this regard, the exchange of experience, including the texts of legislation, among developing countries will be an important step toward South-South cooperation. An important element of national informatics legislation is setting standards and devising rules to enforce them, including technology standards for data, software and hardware and operational standards for documentation and proeedures. These standards should be clearly defined, rigorously enforced and periodically reviewed and updated.

International Cooperafion

Issues and priorities for internatiomal cooperation in inCOmmtits need to be discussed not merely in technological end financial terms, but also in human terms, since the developing countries which are being profoundly affected by these technological developments must also benefit Crom this process of transformation of the world. Lrter-natiamal cooperation can greatly increase the benefits emanating from this technology to both developed and developing countries. For example, the costs of using infortation networks would (all considerably with increases in the number of users, the variety of uses and the diversity of informatiar sources. Providing developing countries with ceduced-rate sccess to these networks would benefit both these countries and the developed countries by lowering unit costs. Developing countries will especially need

international assistance and cooperation in the development of telecommunications. The provision of hardware, [raining and mumtrnancq and the pro-
Vision of adapted and translated software. Development cooperation agencies in developed countries should assist developing countries in improving their absorptive capacities in this field. This assistance might be in the Cotm of training or in the form of grants and loans to purchase hardware for training purposes.
Practical international cooperation can be offered in the field of standards. There is a compatibility standard imposed on hardware produced by the major European manufacturers and IBM. This standard has been adopted by the International Standards Federation. Developed countries can assist developing countries by enforc-ing these standards in their countries. Data standards and recommendations adopted by ESCAP ace also precise enough to be adopted by developing countries. These standards should be made available to any country that wants to build a coherent, comprehensive and cost-effective informatics system.
Additional areas for international cooperation ace: (i) encouraging countries to share existing facilities with others; (ii) evaluating newly produced software; and (iii) critically assessing new and emerging technologies before they are accepted in the **market.**

Conclusion

While discussing informatics for development, developing Countries need to keep in mind four key points:
a) Chan®rag cost structure. Informatics is dramatically changing the way in which busines s being conducted. Even in remote areas, farmers and fishermen can have direct access to market information on prices and supply. This information changes the cost structure, adversely affecting those who do not have access to this technology.
b) Access to international markeu. If developing countries do not have access to this technology, they may be permanently excluded from information networks and thus pushed out of international markets. For example. the Swedish communication satellite which is to be launched in 1990 will crisscross the whole Pacific region and will relay information on any particular area within this region to all Swedish compardes using the satellite service, bypassing the national telecommunication system.
c) Social services to inaccessible areas. Information technology makes it possible to provide services such as education to remote areas via satellite. in many developing countries, the availability of such services could help stem the tide of urbanization.
d) Enhancing cooperalion between developed and developing countries. Informatics provides a unique opportunity far such cooperafion. Developedcountry business ventures need modern infrastructwe and hence will be willing to cooperate with developing countries in assisting with the building of infrastructure.
The developing countries, in their quest for information tech
nology, need to make major efforts in four areas:
a) Infrastructure, which is a precondition for any policy of introducing this technology. The most important parts of this infrastructure are dependable and constant supplies of electricity and a moder» telewmmurdcation system.
b) An institutional structure to plan, promote and coordinate the development and application of information technology in the country.
c) M educated and trained labor force.
d) Guidelines for the purchase and maintenance of equipment so that equipment, once purchased, is properly maintained and repaired.
These guidelines should include a set of rotes to regulaCe standards for hardware and software so that (i) developing countries do not beoome a dumping ground for obsolete technologies; (d) the equipment available witMn the country is mutually compatible; (iii) repair and parts are ensured; and (iv) provision is made for the training of operators.

CHAPTER 2
The Informatics Revolution and the Developing Countries

Maseru Saito

A number of problems relating to the informatics revolution have arisen between the industrialized and the developing countries with the world economy's transifion from an industrial society to an information-oriented society. The imbalanced dirt»bufion of information between the North and South, f»ction caused by gaps in the development of information systems, and constraints on the promotion of development and peace due to the delayed development of information systems in the Third World are good examples.

AgainsC this background, the Macbride Commission was set *up* to study the question of world communications from a wide perspective. The *Many Ciofces, One World* report published by the Commission in 1980 had a strong impact on the problems of North-South communications.' 1983 was designated World Communications Year by the U.N., and under U.N. leadership, activities *were* initiated on a worldwide scale to "promote the development of the communications infrastructure, taking the year as an opportunity to conduct a thorough investigation and analysis of the policies for communicaCions development."

As telecommunications are at the center of modern communication technologies, the International Telecommunications Union (ITU) has long been interested in the problems of North-South communicafions and has introduced various relevant measures. In particulaq the ITU General Meeting of 1485 dealt directly with North-South problems in regard to telecommuncations. Much attention was attracted by its final report, *Thz Missfng Lfnk, which* suggested concrete actions to solve these problems.'

With the understanding that the leadership in telecommunicationa development lies with industralized countries, the QECD has conducted a number of projects in cooperation with the ITU to study the actual conditions of developmental competition in the field of telecommunications and to offer solutions to North-South problems.' One of these solutions is Tide 2000, an DECD project for 1985-87 which wasinitiated with Japan's active support Its first symposium was held in Tokyo in 1985 on the theme of "Telecommunications, Information and Interdependent Economies,"[0] with the main focus on North-South problems. In addition, *The Informatics Revolution and the Developing Countries* was published by the North-South Roundtable' after a consultative meeting in the Netherlands in 1985. The term ' `informatics revolution" was used at the meeting on the assumption that ttus revolution has already begun to affect all aspects of daily life, rather than simply to indicate the presence of a phenomenon which is about to appear. Analysis of past and present phenomena and experiences in those industrialized countries where the informatics revolution is rapidly progressing holds many lessons for developing countries seeking to determine their own responses to this revolution.

The development of the communications infrastructure is indispensable to achieving peace and development by eradicating the wars, famine, poverty and ignorance from which the present world suffers. A lack of communication results in confrontation and encourages violence, while the development of commwncations results in mutual understanding and thereby promotes peace and development.

The informatics revolution means changes in the general social system resulting from epoch-making innovations in information technologes - in particular, the combination of computers and communications, the creation oC new functions, and the urtified utilization of a multilayer network. Major information technology innovations in the fields of microelectronics and telecommunications have successfully combined computers and communications. Information acts as a new currency in an information-oriented society, playing a crucial role in competition under a market economy; and the capitalization of information teas been accelerating.

The potential course of the North-South relationship, which will be partially

determined by the advancement of the informatics revolution, is examined in this paper within a time scale of approximately fifteen years. Transfer theory and Ne systems analysis method are employed to examine the transfer and impact of the informatics revolution, while behavioral science is applied to analyze the behavior of both North and South. Possible changes in the North as a result of the informatics revolution, and this revolution's impact
on the South, are discussed, as are the possible responses by developing countries and the possible types of North-South cooperation.

Changes Caused by the Informatics Revolution

The term "informatics revouton" is used to describe the sweeping transformation of *every* sphere of society being caused by massive innovations in information technologies.
Innovations are generally induced by the corresponding relationship between the need for innovation (N) and the resources (R: including human resources, capital, information, etcJ procured to meet the need. Both N end *R ate* produced and procured in the general behavioral system of society. When an innovation is created by the N-R relationship, in tum produced by this system, the innovation both enriches and upgrades the technological system (T) of the society's behavioral system. If the innovation is sufficiently large, changes in the social system (S: including economy, politics, culture, etcJ and in the value system (V) also occur due to the great changes in the technological system (T).`
The great innovations in information technologies currently in progress *are* not only improving the standard of information technologies, but are also advancing the technological system Ihroup~r their wide application in OA (office automation), FA (factory automation) and other fields. Moreover, they are changing the social system (S) to an information-oriented system through these improvements and advancements, and the value system (V) from a materialoriemted to a Fmowledge-and information-oriented one. II is also true that the advancement of the technological system (T) has liberated our information-related activities from the constraints imposed by environmental factors (E). Many countries, both industrialized and developing, are currently receiving accurate weather information through satellite communication, and the scope of our communications has been steadily expanding.
The informatics revolution is in progress N industrialized countries. Developing countries, however, are struggling to find a way to deal with this revolution while being simultaneously affected by it. They desire both to gain from its advantageous effects and to avoid its negative effects. Figure 1 shows the transfer process of the informatics tevolu8on from the industrialized to the developing countries.
The information-related technological innovations produced by the Na-Ra relationship in an industrialized country are adopted by a society's general behavioral system, causing changes in the Sa, Va and Ea though the Ta, resulting in the informatics revoluton. Some innovations may be exported or transferred to a developing country by means of the Nb-Rb relationship. These are integrated into the general behavioral system of the recipient country and affect its Sb, Vb and Eb through the changes in itsTb.
All industrialized countries are on the course of changing from an industrial society to an information-oriented society as a result of the informatics revolution, and those developing countries which are trying to determine their responses to this revolution include NICs (which have already achieved industrialization), countries just
entering the stage of industrialization, and LLDCs, whose national economies are stilt largely dominated by agriculture. The effect or impact of the informatics revolution on these countries varies depending on their respective stages of development. In the case of those industrialized countries where the revolution is in progress, its effects include those which are currently being felt, those which are still only potential, and those whose assessment will only be possible in the coming century.
In view of the as yet undetermined effects of the informatics revolution, it should prove useful to compare the characteristics of the social systems (S), value systems (V),

technological systems (T) - and environments (E) of an industrial society, an agricultural society where national development is not very advanced, and a future information-oriented society which is now beginning to appear. A futuristic methodology is particularly required for the analysis of an information-oriented society.

Table 1 shows the characteristics of the S, V, T and E of an agricultural society, an industrial society and an information-oriented society. Industrialized countries today are moving toward an information-oriented society. The characteristics of today's developing countries vary depending on their stage of development. While some show the characteristics of industrial societies, others show the mixed characteristics of both industrial and agricultural societies.' The changes anticipated as a result of the informatics revolution are shown by the characteristics of the S, V, T and E of an information_oriented society. The effects, utilization methods and diffusion period of the informatics revolution will, however, vary depending on the characteristics of the society where the revolution is introduced. The important point is that the impact of the revolution will largely depend on who utilizes it, for what purpose, and how.

What kind of problems may be generated between industrialized and developing countries due to the advancement of the informatics revolution?

First, the capitalization of information will result in the national strength being more dependent on information, and the information network of a developing country will be integrated into the worldwide network. Whether or not the mutual dependence between industrialized countries and developing countries will be one of equality or subordination will be determined by the basic philosophies and efforts of the countries in question.

Second, the manifestation of the international division of labor Will be the polarization of the South to an industrial economy based on primary products and of the Notch to a service and information economy. As shown in Cable I, the eenaal production factors in an industrial society are labor and capital. Similarly, capital and scientific technologies (information) are the main production factors in an information-oriented society. The development and use of robots has already become popular in industrialized countries through the ME (microelectronics) revolution. As "steelroollat wockere," industrial robots now form a third power force. With the introduction of FA and OA, these steel-collar workers have begun to replace blue-collar and white-collar workers in an indusfial society. As a result, the re(afive superiority in labor-intensive industries has been shifting from the South to the North.

Third, the transfer of production factors between the North and South will be facilitated. With the inception of the informatics revolution, the transfer of capital can be easily accomplished anywhzre in the world. Large transfers of informotion, scientists and engineers are expected to take place in the future. In the case of information, however, there is the problem of legal prohibitions against data transfer overseas, and there is a brain drain problem in the case of scientists and engineers. In addition, new employment opportuttities will be created due Io Che emerge»ce of new industries following the informatics revolution. The manpower demand in the software field will particularly increase, paving the way for international employment- Multinational corporations have already established a number of software companies in developing countries.

Fourth, the informatics revolution will alter both the international and domestic structures of communications and their control. increasing the tendency For a worldwide centralization or roncentration of information in a small number of industrialized countries - and the dependence of developing counMes on them. With the development of an automade translation device, information collection and processing will become Car easier than ai present, breaking down the language barrier. II is certain that a country *which* has e large share in the worldwide infortnat[on 'system and a strong technological advantage will have more influence and power than othersOn the domestic seine, if an information system is controlleJ by a particular goup in an undemocratic manneraod is unfairly used. the introduction of the informatics revolution in that country will have an adverse effect on the country's development end peace.

When the informatics revolution begjns to make its way into the general behavioral system of a society, how do the technological system (T), the social system (S) and the value system (V) respond, and what kind of North-South cooperation can be expected? The informatics revolution in industrialized countries is the result of a trialanderror process relating to information-related innovations, in turn developed through the N-R relationship. The characteristics of an information-oriented society shown in table 1 are only forecasts based on the futuristic method; they are not necessarily inevitable. Even though the informatics revolution reflects the needs of society and achieves certain desirable effects, it may have a negative impact, such as the generation of a new type of disease affecting industrialized countries. The informatics revolution will create new information-related industries and will promote the activities of multinational corpora5ons utilizing these industries. However, the advantages of an early start *are* offset by certain risks.

In comparison, developing countries can use the indusMalizedcountry experiences to select those aspects which will contribute to their own development and peace. Although they cannot enjoy the advantages of an early start, they can enjoy the evaluative benefits of a latecomer. Many developing countries Cear that they may be left behind in the new developmental stream of the world if they fail to catch up with the informatics revolution. In the context of an industrial society, the North-South problem is one of sharing the same development path. In regard to the informatics revolution, however, the North and South are on different development paths - the South toward an industrial society and the North toward an information-oriented society.

The response of the technological system (T) to the informatics revolution centers mainly on the transfer of information technologies from North to South. Most developing countries need to introduce information technologies (Nb) but lack the necessary resources to do so. When these technologies are classified into production technologies and utilization technologes, the former generally require a large amount oC high level resources. In contrast, the latter require less resources for a IransCer to be effected. In view of the fact that most developing countries lack sufficient resources 20 pagegaps? If the informatics revolution is introduced in a distorted manner to benefit the ruling class, the rich or the modern sector, these gaps will svnply widen.

The national development efforts of any developing country have so far concentrated on industrialization and modernization. While it is true that industrialization and modernization have stimulaced urbanization and that many development programs focus on cities, this development pattern has widened the gap between urban and rural areas, which in turn is one cause of unequal income distribution, the distorted relationship of regional economies, and various social and political instabilities.

In most developing countries; a larger proportion of the population lives in rural areas. World Bank figures indicated That the ratio of the agricultural population in 1954 was 77 percent for low-income countries and 51 percent for middle-income countries; the share of agriculture in GDP was 36 percent for the former and 14 percent for the latter. However, despite this heavy dependence on agriculture, many countries *are* suffering Crom poverty or *even* starvation. While urban areas tend to benefit from national development projects, the coral areas, where the majority of the population lives, are under a great strain due to distorted national policies.

A number of problems intersect in rural areas, and it is absolute
ly essential that these areas be developed in order to eradicate poverty and starvation and to close the urban-rural development gap. The international assistance provided to developing countries has to date excessively focused on industry and on urban areas. In the future, this focus should be shifted to rural development, which has been relafively neglected so far in development strategies. This stress on rural development should also be supported by the BHN (basic human needs) concept.

Efforts toward social, educational and medical development and political modernization

must be simultaneously implemented for successful rural development. The introduction of RCCs (rural communications centers) will be necessary to coordinate development efforts in each rural community.°

Culturally, the informatics revolution can be used to spread a new culture and to promote national identity. Methods of using informatics in education *are* already being examined in many developing countries. The fruits of the informatics revolution could be better utilized by such culture-related industries as educating printing, publishing, entertainment and the arts than they are now. The introduction of intermediate Yechnologies (not necessarily advanced technologies) relating to printing, bookbinding and pubbshing in developing countries should greatly improve their educational and cultwal standards. Technology transfers in this field conspicuously accelerated in the latter half of the 1970s. in terms of the number of book publications, the comparative shares of the South and North changed from 15:SS in 1975 to 25:75 in 1983, which shows a rapid increase of publications in the South. In the case of TV installations, however, the comparative share oC the South increased only slightly, from 5:95 in 1975 to 8:92 in 1983.' In regard to the total nuDaber of broadcasting hours per day, while 5 industrial countries offer a daily average of approximately :4 hours, developing countries offer far less-e.g., 6 hours 46 minutes in the Middle East and Africa (average of 9 countries), 12 hours 38 minutes in Asia and Oceania (average of 13 countries) and 16 hours 53 minutes in Latin America (average of 10 countres). A big gap in the information flow between North and South also becomes evident when the number of channels is taken into consideration. The information supply capacity must be impeoved to increase the flow of information ua developing countries. The composition of programs in developing countries (average of 32 countries) is 17 percent for educational programs, 17 percent for news progams, 50 percent for entertainment programs and 16 percent for governmental and other programs.

There are many fields in which North-South cooperation is possible in terms of progam supply, and cooperation efforts should be expanded in the future. The value systems (V) of developing countries are largely affected by the information concerning industrialized countries received through the mass media, and this information can facilitate the transition from a value system based on traditionalism to one based on rationalism, the mutual recognition oC the different ideologies involved, and the discovery of specific national characters. Moreover, moves on the part of industrialized countries to absorb the cultures of developing countres have been fairly noticeable in recent years, one example being the Asian Film Festival held annually in Japan.

North-South cooperation in the field of telecommunications has a relatively long history. Telecommunications are not only the main means of communication, but also act as an infrastructure for nafional development and modernization. 'Telecommunications can be used as a powerful driving *Corce* for economic development in terms of the dissemination of technological innovations, market expansion, rational and effective resource distribution, time and space saving, and information exchange. Politically and culturally, ta3ecommunications can also play an important role in increased participation, closer communication, efficient administmfion, information exchange, etc.[1]O

In short, acting as an economic infrastmeture, telecommunications can achieve significant development and modernizaton effects with a relatively small investment.

Future of the NorthSouth Relationship

With the advancement of the informatics revolution, what kind of scenaios can be envisioned for the future of the North-South relationship? Both the North and South have their own ideal scenarios, and the possible courses of development of the North-South relationship are examined here taking these scenarios into consideration.

The North has two alternative scenarios to choose from. De. pending on who leads and controls the progress of the informatics revolution, either unipolarization (scenario A)

or multipolarization (scenario B) will result. The former describes a situation in which a single country (for example, the U.SJ largely controls the information revolution, while in the latter situation, the number of leading countries in the information age increases (including, for example, tare U.S., the E.C. and Japan).

Than South also has two alternative scenarios. The first (scenario C) presumes a continuity of development in developing countries, i.e., a structure where development In N1Ca, LDCs and LDCs affects development elsewhere. The second (scenario D) presumes a discontinuity of development between these groups of countries.

Figure 2 shows the possible development scenarios for the North South relationship based on the coupling decoupling of the N-R relationship between the North and South and on the character of North South communication. In terms of the N-R relationship two possibilities exist, depending on whether or not the coupling is easy. In terms of the communication character, there are also two possibilities: subordinate and independent.

Here, the term "coupling" means the coupling between the Na-Ra and Nb-Rb in the transfer process of the informatics revolution. Given a strong desire to transfer the informatics revolution, the achievement of the above coupling will be difficult if the access of developing countries to the informatics revolution in industrialized countries is severely limited, or if the absorptive capability of the developing countries is poor. The possibility of achieving this coupling is greater for NICs than for LDCs, and for LDCs than for LDCs. The character of communication is judged on the basis of

whether or not the South possesses subjective independence in the transfer of the infortnatira revolution.

FIGURE 2
Scenarios for the North-South Relationship

North"s Scenarios	N-R Relationship	Character Communication NC Subordinate	p°t~n	South's Scenarios
(A) Unipoluivarion	Smooth coupling	I	11	(C) Continuous development
(B) Multipolarization	Bumpy coupling	III	IV	(D) Discontinuous development

Based on combinations of *the North's and South's original scenarios,*

there are a total of sixteen scenarios. Scenario C_II is the mostpreferable for the South, where continuous development effects between different groups of developing countries make possible Lhe smooth coupling of the N-R relafionship. The achievement of scenario B-II (multipolarization on the part of the North and an independent character of North-South communication) in the case of the North is advantageous for the South in the pursuit of its own objective, i.e., scenario C-II.

In realitg however, the state of the South is almost identical to scenario D. *Internal Imde and the movement of production factors in the South are extremely small, indicating its dependence on the North. There is far less communication among developing countries than among industrialized countries. Great effort and cooperation on [he part of individual countries will be required to stimulate trade,* I the movement of production factors and communication within the South in order for it to move Crom scenario D to scenario C. Attention should be paid to cultural cooperation and cooperation for communications development with neighboring countries.

In the North, Japan and Europe are moving toward scenario *B.* Advantageous competitive status in the software and hardware fields must be secured in order to secure international control of the Informatics revolution. While multipolarization in hardware competition is progressing in the North, however, multipolarization in software competition is delayed. If the North moves toward scenario A, the relationship with the developing countries described by scenario A-I will become closer, but the transfer of the informatics revolution to those developing countries showing an independent character of communication via-a-vis the North will be delayed.

However, iC the North moves in the direction of scenario H, the subordinate or independent character oC communication on the part of the South will not have much importance because of the expected competition between countries of the North in providing the South with access to the informatics revolution.

Except for a few countries, Scenario q-111-D is the most un desirable for both the North and the South. The North and South ,will have to work hard to convert the character of the N-R relation ship from "bumpy coupling" to "smooth coupling" to facilitate the progress of the informatics revolution. The North should opt for Scenario *B* and the South for independence in order to secure sound competition in this process. Moreover, the South should try. to move away from Scenario D to Scenario C (or successful worldwide development, and it is desirable that the North support this attempt on the part of the South.

All NICs have already been affected by the infommatics revolution and, except for LDCs, most developing countries will have been similarly affected by the year ?000. The informatics revolution will also affect the East-West problem, given its close relationship with North-South problems. Ideological confrontations anmong industrial societies may gradually weaken until they are almost nonexistent. In recent years, in fact, many developing countries which used to follow sMct socialist lines have partially adopted development policies based on a free market economy which ure achieving high growth in other developing countries. China is a good example of [his. As the infomatics revolution can establish a worldwide network where accurate and diverse info

ased on this analysis, the following points can be made:

a) In the selection of a scenario for the development of the North-South relationship, Scenario B-II-C, characterized by a smooth coupling of the N-R relationship and an independent character of communication between the North and South based on efforts to achieve multipolarization in the North and continuous development in the South, is the most desirable.

b) As the informatics revolution in the South is largely dependent on the transfer of technologies from the North, an assessment system should be established to select the

most effective technologies Cor the development of the South. The transfer of inappropriate technologies or the fostering of dependency will cause the transfer of technology to eventually fail. The cooperation of industrialized countries in the provision of resources is essential for those developing countries where resomees are scarce.

c) Both the domestic and international utilization of infor mation technology innovations should be conducted based

on the principles of fairness, equity, justice and democracy. The monopolization of the informatics revolution or the existence of a subordinate relationship in the communications network will hinder the development and peace of individual

countries and that of the world as a whole. In other words, Scenario B-II-C cannot be achieved under such circumstances. The Geedom of the press and guarantees of equal access to information are issues often raised in North-South and East-West meetings on information. The denial of information results in conflict, while the mutual exchange of information results in reconciliation and mutual understanding.

d) Some application fields of the informatics revolution are not affected by international relations or the degree of modernization in a society-tor example, theimprovement or spread of culture, or the setting up of safety and medical systems. Telecommunications play an important role in disseminating knowledge about science and technology, art and literature, etc.

e) Cooperation not only between the North and the South, but also within the South itself, will be indispensable for the establishment of a new global information order. Such

cooperation activities will be especially useful in the fields of satellite Station and the exchange of scientific and technological information.

Good guidelines far the development of the informatics revolution are contained in the Tokyo Declaration, announced by Japan at the World Communications Conference in Tokyo in 1983." The main objectives of this Declaration were (i) the establishment of targets for an information-oriented society, (ii) the expansion of international cooperation, (iii) the promotion of the establishment of an informational database and (iv) the consolidation of solidarity with Asian countries and of Japan's information-sending function.

CHAMER 3
The Informatics Revdution and Development: ,9 View from Japan

Michio Nagai

We ace experiencing today a large-scale revolution in the fields of both information and communication, which brings us from the stage of an indusMal society to that of an information-oriented society.

The industrial revolution of eighteenth-century Europe prodoted a strong impact on the course of history, not only in Europe, but [h[oughout the world. The computer and communications (C and C) revolution has already brought about many changes in the areas of science and technology and is now beginning to influence economics, politics, education, security and cWture - in fact, almost all aspects of human life.

By the next century, the C and C revolution will have had an impact on the course of world history as Car-reaching as that of the industrial revolution. Howeve[, looking to the Cuture, we cannot predict whether the benefits brought about by this revolution will outweigh its costs to society and leave mankind better off than before.

Of all the problematic possibilities of the future, one of the most important is the danger of polarization between those countries that can rapidly diffuse and utilize the new technologies and those without such capabilities. This new dichotomy is already creating a new international crisis, and this crisis could worsen.

Efforts must be made to promote the transfer of technology, taking into awount the needs and development strategies of individual developing countries. While developed countries must try their best to transfer new technologies, developing counMes must also be ready to receive and incorporate them into their social systems.

The Case of Japan

The *case* of Japan illustrates the importance as well as theindustrialization. Many Japanese regarded this as synonymous with wesfernization. In Cact, Mori Arinori, who became the first minister of education, science and culture in the new government, proposed at one point in his career that in order to modernize communication, both domestic and international, it would be wise for the Japanese to abandon their language and adopt English as the national language, teaching it to *every* citizen of the country through compulsory schooling.

Professor Dyer, a British scholar who became the first dean of the Tokyo University Engineering College; taught his students that Japan's primary task was to achieve independence and survival. He urged young, ambitious students to faithfully copy the model of the West as quickly as possible instead of wasting their time in original research. The lapanese government was also interested in absorbing westem ideas in a short time. It spent about 30 percent of the annual educational budget on inviting scholars from the West to Japan and in sending Japanese students to westem academic institutions.

Clearly, the Japanese in those days keenly felt the impact of western civilization and saw the acquisition of western values as something indispensable for their independence and development - even to the extent of abandoning their indigenous culture.

Cultural /dentiry

It was obvious to most Japanese, however, that they could not be westerners no matter how obsessed they were with constmcting a faithful imitation of western civilization. Understandably, a good number of intellectual, political and business leaders asserted the importance of maintaining Japanese cultural identlty in education, aesthetics, morality and other matters. From the latter half of the nineteenth century to the present time, the Japanese have been caught in the dilemma of pursuing western civilization or maintaining their traditional cultural identity. This dilemma has often generated strenuous efforts to create a compromise and harmonize the two courses. This strong source of tension has produced an energetic creativity which seems to be essential for the development of a new sociocultural system in a developing country like Japan.

Planning and Freedom

when a developing country tries to achieve a certain task, planningrng by a group of talented individuals is essential and indispensable. In the case of Japan, there was a strong bureaucratic tradition even before modernization - a tradition that had been established by a warrior class, the so-called samurais, during feudal time traditional structure was retained and utilized to the utmost modernization w mss. This even survived intoatherhated in the nineteenth century after steel, the Present time. Large industriy' and it has primar a postal system, the railways _ and~-shrpbuilding,

Y nd higher education wsocial sectors such as fared by the bureaucratic authority all carefully planned and Forei adminis valuable contributio Party°rPated in the plannin develo ns' esPecially Burin g Process and

The spread of education among the entire remarkable achievement It was not conducive,

PoPWation was a

however, to the

development of a free and democratic society. A lesson we may draw from this fact is that, in our efforts to industrialize a developing

i nation, it is Important that the process of industrialization benefit not only a handful of elite, but the entire population.

World Crisis

Developing countries today should thoroughly realize that they are now faced with problems that did not exist before. What the Japanese experienced a little more than a hundred years ago was difficult enough. After some struggle, they were able to understand the nature of the problems and to agree among themselves that the target for Japan - an agrarian, feudal society - was to bring about indusMahzation on a national scale. Today, there are severe limits to what an emerging nation can do by itself. The world community as a whole is moving from the stage of an industrial society to that of an information-oriented society. Multinational companies are already operating beyond the boundaries of sovereign states. Their markets are no longer confined to individual nations; the whole world has become their province.

Whether peoples of the Third World like it or not, Bte world's macroeconomic structures

have undergone a tremendous vansformation. For example, secondary indusMes have changed gently due to the application of highly developed information and communication technologies. Their products are manufactured more efficiently and at a lower cost. Unless Third World countries become aware of such changes and make the necessary adjustments, *they* will be unable to stand up to worldwide economic competition. Their economic growth rates will remain low, and unemployment rates will rise. As a result, tension will be heightened both within the countries of the South and between the counMes of the South and the North.

The Japanese case shows how important it is to have persons in responsible positions who are able to articulate ideas clearly, to understand the nature of the crisis and to Coimulate ideas, plans and methods for their implementation. So far, however, our understanding of the nature of the crisis brought about by the informatics revolution is very limited. It is true that valuable reports have been written and published by responsible commissions related to international institutions, such as *Mane Voices, One World'* by a conunission chaired by Sean Macbride and *The Missing Link'* by another commission chsired by Lord Maitland. Cocking around in Japan, it appears that the nature of today's crisis has not yet been *understood* or grasped clearly even among college ~aduates. There should be tar more frequent, indepth and widespread discussion within and among as many nations as possible, and especially between the peoples of the North and the South.

The focmulafion of plans is essential foe restructuring the social, economic, political and educational systeurs of a country. Responsible bodies such as the government, mWtinational corporations and universities must zoopecete to fonnu(atz such plans in xs many nations as gos,ible. These national plans could sulzsequently 6c examined by international bodies. At first, plans may be tooldeaE, tic and abstract. However, some countries oP the South, such es N(Cs, shoutd take the Lead in describing what concrete steps they have taken for transforming the various systems. This could point the way for the less developed countries.

Not all changes can wait for the fomndation of governmental master plans_ [n many developing countries, such as ludic and Hraz[I. microcomputers are already bung used to prwnote eff~cizncy in such areas as health care, administration, agriculture, education and transportation. Telephone communication systems are also being improved in many developing countries. The use of rodio. television and video is spreading. These scattered and spontaneous activities are• nonetheless valuable and should bz taken accowri of in s carefully reformulated. ilzxible nntional plan.

Messages of warning are >enY out repeatedly about the hunger and poverty that plague the People of the South. Third Wodd counMes suffer the burden of enomtous accwnu)eted debts, and many of them also Case n crisis o1 cultural identity. However. on the brighter side, two of the superpowers are t7nalty sitting down together to work out on agrzeement for arms reduction. On the dzvi9oping country side, a goad number *oP* MCS are shaving a surprisingly strong economic and technolo®ral potential.

The countries of the North should eve stronger financial support to the countnes of the South. More important than maney. however, is to share a common undemanding about the nature of [he crisis and on *ways* to restructure the world community.

m¢nso wagays~

Notes

1. UNESCO/Sean Macbudc, In[ernalional Commission for the Study of CommuN-cation Problems, Many Voices, One Wadd (Paris: UNESCO, 1980).

2. In[cmalional TelaommuNceGon UNOn pTU), The Missing Link (Geneva: ITU, 1985).

CHAPTER 4
The Ten Commandments ojTokyo
Michael D. ICirby

lAt the clrxi'e of the Tokyo Round, .tusdce Michael KiMy of Australia presented the

following summary of the major issues in infamtaties for development and suggested some prircciples to assist in setprtg prrorrdes for intemaNonal cooperation. j

I. Ethics/ va/ues. In the development of an informatics policy, pay attention to ethical and human values. Build defenses for cultural, linguistic and social variety. Be aware of new social problems such as unemployment, social dislocation, and the need to protect privacy and confidentiality. Be equally aware of new opportunities, e.g., leisure.
2. Peace. Consider the contribution to be made by an informatics policy to world peace. The exchange of information could reduce the risks of antagonism built on ignorance.
3. Compatibility. Attend urgently to the need for compatibility between systems in the hope oC avoiding unnecessary disparities and expensive incompatibilities between systems. This may be achieved by establishing internationally accepted standards in both hardware and software.
4. Transnationol coryorations. Keep an eye on the special role in informatics of the private sector in general and of multinational corporations in particular. Many such corporations have a good record as corporate eifizens, but the very size and power of such corporations, and their insusceptibility to domestic control by individual countries - and even groups of countries - pose new problems for achieving agreed national and international goals.
5. Brain drain. Attend to the special problems and difficulties posed in the field of informatics by the brain drain phenomenon, The international features of informatics guarantee the intemetional utility of technological skills. Defenses against the loss of talent include the training of trainers in the environment of developing counties.
6. Dumping. Beware of the dumping of outmoded and already supervened technology. In informatics, this is a special problem due to the speed of technological change and because the cost of equipment frequently drops, making the purchase of outmoded technology doubly disadvantageous.
7. Soc7nlls7 countries. Attend to the special development needs of the socialist countries in order that their development may be integrated in an appropriate way with that of other countries.
8. Realism. Be realistic in setting goals for information and informatics policies.
9. Optimism. The dynamic and evolving nature of informatics as an international technology encourages general optimism about the Long-term impact of informatics on everyone, including the developing countries.
10. Institufions. The need for institutional arrangements to attend to the many policy problems presented by informatics - whether technological or sociahhould be an urgent concern of the international community. The DECD has served developing countries well, but there is no truly international, universal, accepted and effective agency to coordinate Lhe aggregate policy studies concerned with informatics issues. UNESCO has been a late entrant to the field. IBI has not enjoyed universal participation. The pressing need for coordinated international attention to informatics issues is demonstrated by the urgency, difficulty and variety of the issues now under discussion.

CHAPTER 5

Informatics for Development The Indian Experience

Ashok Parthasarathi

Unlike in most other developing countries, the development of electronics in India has been spearheaded by the professional sector rather than by the so-called consumer sector. 71ws, telecommunications, industrial electronics, control systems and instrumentation, and computers have played a much more important role than radio or TV receivers, VCRs or hi-fi equipment. This is largely due to three factors. First, starting from the time of independence in 1947, electronics has been regarded more as a capital goods industry than a consumer goods industry. Second, the state has played a larger role than individual consumers as a user of electronic goods. Third, the state has played a major role in the whole electronics development process through planning within a mined economy in a poor country.

The first electronic company set up after independence was the Indian Telephone Industry pTq in 1948, followed by Bharat ElecVonics Ltd (BEL) in 1954, focusing on defense electronics and broadcasting. Instrumentation Ltd. came up in 1965 to deal with the area of process control systems, and the Electronics Corporation oC India Ltd. CECIL), Conned in 1967, dealt with nuclear instrumentation, computers and professional components. All of these were publio-sector companies promoted by the government of India. The 1970s saw the spawning oC a number of publicsector companies by the state governmenzs, covering the whole range of professional electronics as indicated above. A major impetus to this key position of the public sector in professional electronics in general and telecommunications and computers in particular was the Industrial Policy Resolution passed by the Parliament in 1956, which reserved telecommunications, broadcasting and defense electronics for the public sector, a position which applies even today, except for terminal equipment to be installed at the subscribers' premises, e.g. telephones, facsimile and EPABX.

A concomitant of this approach was that the R&D structure to support the production structure also developed in the public sector, in the farm of both R&D units within publicsector companies and independent R&D institutes associated with major user ministries, such as defense and telecommunications.

The institutional structure set up to plan, promote and coordinate the development of the electronics industry included an Electronics Commission at the policy level and the Department of EIecVOnics at the executive level, with the prime minister as cabinet minister for electronics. The Commission and Department were given a broad charter to deal with all aspects of electronics, given the responsibility of "attaining maximum self-reliance in the shortest possible tlme," and vested with extensive powers for the purpose.

Informatics Infrastructure

Terrestrial Telecommunication *Systems*

At the time of independence, the switching nodes consisted mostly of mama! switchboards and the transmission (inks mostly of open wire lines with some carrier systems working on them. Subsequently, automatic switching using electromechanical equipment and analogue transmission links on coaxial cable, microwave and UHF were introduced. With the progressive availability of these wide-band systems and automatic switches, STD service was introduced. Recenlly, diAtalswitchingnodesandsomedigitaltransmission systems have been added.'

'Three layers of telooom transmission can be distinguished; the subscriber lines, interexchange (junction) lines and the Trunk network. As per the data of the Department of Telecommunications, the subscriber and junction networks are composed mainly of 20 million pair-kilometers of copper woes and a small component of microwave channels. The long-distance transmission network is more diversified and consists of 29,OOD route-kilometers of coaxial cable, 33,OOD route-kilometers of microwave systems, 17,000 routekilometers of UHF systems end a few hundered kilometers of optic fiber systems.'

As for switching, the network consists of both electromechanical and electronic exchanges-local, transit and trunk The equipped capacity of the network as of 1986 was 3.2 million telephone lines.

The average cost of providing one telephone connection to a subscriber is running at around Rs. 30,000, so that every 1 million additional telephones cost the government about Rs. 30 billion. The investment of Rs. 60 billion provided for telecom services in the Seventh Plan (1985-90) is therefore targeted to add 2 million new telephones to the network over 1985/86 to 1989/90, taking the total number of telephones in operation at that time to about 4.4 million.

However, most of this investment and expansion is to go into the urban areas - the 4

metropolises of Bombay, Calcutta, Delhi and Madras, some 25 industrial cities, and around 100 of the 3,200 towns in the country. This is because rural areas still do not have any significant effective demand for telecom in commercial terms. To make the rural telecom investment more cost-effective and to provide greater access to telephones, the Seventh Plan provides for the operationahzation of some 9,000 long-distance public call offfces in small towns and villages, linked through small Rural Automatic Exchanges (RAX) and muhiaccess narrow-band radio transmission systems.

INSAT

India was perhaps the first developing country to have planned a domestic geosynchronous satellite for a variety of communication and other services, with procurement action undertaken as fat back as 1977-78. INSAT,' which has been operational since 1983, is a multipurpose satellite providing point-tp-point and networked telecom, direct broadcast capability for TV (though it has also been exploited to provide various new telematic services after the satellite became operational) and a remote-sensing instrumentation package for meteorology. It is a multiseries satellite system, with the present INSAT-1 B satellite committed to be followed by 1 C in mid-1985 and by 1D in late 1989. Each satellite provides 7,000 voice channels of telecom service and two high-power TV broadcast channels. The satellite has played a major role over the last five years in both catalyzing and supporting many of the informatics/telematics services and applications dealt with in subsequent secfions of this paper.

Computers

Historically, the main computer manufacturing activity anti
the mid-!9805 was concentrated in the public sector company,
ECIL, the multinational subsidiary International Computers Ltd.
(India), and three or four companies in the private sector. ECIL
made a family of 16-bit and 32-bit minicomputers of its own design
for govemment, business and higher education uses. It also developed and manufactured both the specialized hardware and software needed to apply these computers tohigh-performance, real-time applications, particularly for the defense, telecom and atomic energy markets. ICL (India) and the three or four local private companies made minicomputers for the general business market.
However, the advent of PCs in the early 19805 had a profound effect. In November 1984, the govemment announced a new computer policy which laid emphasis on promoting the use of PCs and micros by reducing import tariffs on parts for central processors and peripherals so as to increase the total size of the market. This has given a tremendous boost to the computer industry, with the number of manufacturers increasing to around 50 by the end of 1986 and with computer sales growing at an average of 70 percent over the Iast three years (see table 1). Table 2 shows the buildup of sales of microcomputers and minicomputers *over* the last three years, while table 3 show the distribution of these sales by type of customer over this period.

7AHLE 1

Esfimeted Value or ComputerSyatema8old

Yeet	Re.Milaons
1975	7gp
1976	350
1977	410
1978	450
1919	570

1980	600
1981	a80
1982	750
1983	900
1984	IZ00
1985	7p00
1986	7,800

SOURCE: Misdaterl reply to umtetred question no. 8353, Rajya Sebhe, 30 Apaa 1986.

TABLE 2
Sales of Micros and Minis (Rs. Billions)

Type	Sales in		
	1984	1985	1986
Micro	26	103	200
Mini	5	11	12

SOURCE: "TheDQ Best-Selling Machines 1985-86," Dataquest (New Delhi), October 1986

TABLE 3
Customer Distribution

Type	Govt.	Public Sector	Banks	Education R&D	Private Sectors
Micro	9	22	29	6	34
Mini	23	14	7	14	42

SOURCE: 'The DQ Best-Selling Machines 1985-86," Dataques*t* (New Delhi), October 1986.

The overall picture is that there are some 50,000 computers in the country operating in some 25,000 commercial, government, research and educational institutions. The target set for computer production in the last year (1989-90) of the Seventh Plan is 100,000 computers, mostly micros, minis and super minis.

Persnnpower Generation

The gap between the availability of and demand for skilled personnel to design, manufacture, apply and maintain computers and develop software packages for using them is estimated to rise to 80,000 by the end of the Seventh Five-year Plan (1989-90).

As against the requirement, the stock of professionals who have received computer education/training from recognized institutions is estimated to have been about 5,000 in 1985-86, while the number of professionals required to implement even the existing computer activities optimally is 13,000.

To reduce the personpower availability gap, the Department of Electronics has initiated a numberofeduration and training programs jointly with the Ministry of Human Resources Development (MHRD).[5] Tha Department of Electronics is also supporting programs for continuing education and fo7 computer engineering/ maintenance. The National Informafics Centre of the Department of Electronics conducts training programs for government personnel in computer use; the Regional Computer Centres of the DoE at Chandigarh and Calcutta conduct short duration and intensive courses; and CMC Ltd., a publ}CSector company in the field of computer services, has set up training centers in 24 places to provide professional training at various levels, from primers for entry-level personpower to system software, databases, networking and artificial intelligence(expert systems.

Industrial Capability
Telecommunications Industry

The major producer of telecommunication equipment for civilian use is the Indian Telephone Industries (ITI), The company has a work force of around 30,000 in seven plants, producing around Rs. 4 billion worth of telecom equipment *per* year ITI, which is the country's sole producer in the area of switching, currently turns out around 200,000 lines of electromechanical exchanges and around 120,000 fines of-digits} electronic exchanges per year. The drive toward full digitalization of the telecom network by 1995 has necessitated the setting up of three new plants for making digital Switches for local exchanges of the public network, each with a production capacity of 500,000 lines per year. The first of these, set up in technical collaboration with CIT-Alcatel of FtanCe, started production in 1985 and is expected to reach its full capacity in 1989. The second is to 6e launched in the near future, while the third is to start in 1991_ The third plant, it has been decided, will manufacture digital switches ranging from a capacity of 4,000 lines Co 16,000 lines each, indigenously designed by the Center for the Development of Telematics (C-DOT), a governmentpromoted and funded technology development organization. However, the type of switches to be made by the second plant has yet Co be decided.

To meet the needs of the tmnk network, an ITI plant at Palghat in Kerala with a capacity of 30,000 trunk exchange lines per year (equivalent to 90,000 lines of local exchanges) is being set up. This plant is to be expanded to 100,000 tmnk exchange lines per year during the early 1990s.

As for Rural Automatic Exchanges (RAX), production of a local-cum-trunk digital exchange of up to 512 lines capacity, designed and developed by ITI, is to start soon at ITI's plant at Bangalore in Kamataka. In addition, the state electronics corporations of some five states are to undertake production of RAX using the digital technology developed by C-DOT.

Digital switches at subscibers' premises, viz. Electronic Private Automatic Branch Exchanges (EPABX), are just coming into the market Crom production in a number of public-sector and privatesector companies. Many of these use the technology developed by C-DOT. However, some are based on foreign technology purchased from French, American and Japanese compares.

Telex exchanges of the electromechanical type *have* been the only ones manufactured so far, all by ITI. However, the publicsector company ECIL is soon going into the manufacture of elecVonic telex exchanges under license from a leading West German company.

As for transmission, the country makes a whole range of equipment and systems, from lowend VHF to high-end microwave radio relay and satellite communication terminals. ITI, HEL, ECIL, Gujarat Communications and Electronics Ltd., Maharashtra Electronics and Punjab Communications, all public-sector companies, contribute to the total production base in different product lines. Projects for the manufacture of broad-band digital microwave radio systems and optical fiber communication systems have been recently authorized, and production of both these "backbones" of the alldigital telecom network of the 1990s i3 to start within the next two years. These projects have all called for major investments by the government of India.

The digitalization target for the 1990s makes huge demands on the production capacity far digital (PCM) multiplex equipment. Therefore, some six public-sector companies have gone into the manufacture of this equipment, all based on state-of-theart technology developed by the Telecommunication Research Centre of the Department of Telecommunications. The key microchips used in The computer industry had grown at a combined rate of arom

10 percent per year during 1975-80, The industrial and technolo] policy for minicomputer and microprocessor-based systems w; announced by DOE in 1980. As aresult, ^{the}numberofmanufacmre$_r$ confined to three or four units prior to 1980, spectacularly increase to *over* forty units by 1984,

As indicated earher, with the new computer policy of Noverr bar 1984 becoming operative, there has been a steep increase in computer (mostly microcomputer) sales. Aa far as the PC market concerned, which is the fastest-growing market segment, the competitian is between

four major vendors: HCL, Sterling, Wipro and Eiko
The competition between them has forced PC *prices* down from Rs. 100,000 in 1984 to Rs. 20,000 in 1987,'
International Computers (India) Limited, mainly a minicomputer and super-mini systems vendor, is the company with the largest turnover at Rs. 290 million in 1986. The number-two position is occupied by HCL, a PC-strong company, with sales of Rs. 240 million, while ECIL, a large-system company, stands at third position with sales of Rs. 210 million.°
The top ten manufacturers who account for 80 percent of the output are showing strong indications of becoming. professional computer manufacturers in terms of hardware product quality, the range of software supplied and developed, and customer support. The remaining 20 percent of industry output is accounted for by some 70 small units, mostly engaged in assembling computers fromimported kites.
DOE has set up a Centre for Development and Production of Computer Mainframes with a view to attaining self-reliance to meet the computational requirements in such vital areas as atomic energy, defense, *power,* oil, steel and space research. The project, which started in April 1986 will be undertaken by the leader of the computer industry in the country, ECIL, in collaboration with the Control Data Corporation. The product range includes CDC's Cyber 810 and 830systemsandvadants thereof, EC1L is also manufacturing Norsk Data NI}500 Series supervmini computers. Some private companies are starting joint ventures to manufacture super-mini systems in collaboration with leading international computer manufacturers. Hinditron has signed up with Digital Equipment Corporation (DEC) to manufacture the VAX-II series of computers, while Data General has fled up with Patni, Tolerant with HCL, Olivetti with Modis, and *[CL (U.KJ* with *ICL* (India).

A computer is only as versatile as the software used with it. During the 1960s, the manufacturer used to supply the basic system software alongwith the computersystem. Customers *were* responsible For development of application software. However, by the 197DS, the concept of modular software came to assume great importance. Software was 'Lnbundled," i.e., users had to pay for software separately. Associated with the high cost of software development, this change has led to the emergence of an independent industry specializing in the development, production and sale of software.
The. software industry is labor-intensive in high-level human resources. With its large pool of scientific and technical personpower, India is extremely well endowed from the supply side to enter this new industry. On the demand side, there is the combination of India's, own growing needs for diverse types of software and the annual growth rate of 15-25 percent in the global computer industry.'
The existing industrial base in software consists of capability maiNy in the area of application and customized software. However, capability also exists in the publicsector companies and laboratories for the technically more demanding system software, such as basic operating systems, compilers, device drivers, etc., mainly for micro and minicomputers. System software, including operating systems for mini and large computers, is mostly imported. Software For Supervisory Control and Data Acquisifion (SCADA) used in on-line informatics and tetemafic systems in the powerjoil/gas and other industrial sectors is partly imported end partly indigenous.
Computer software has been recognized by the government as a thrust area. The Department of Electronics has drawn up ambitious plans for exports by developing a software industry capable of producing packaged software. During 1980-85, exports of computer software grew eight times, tram *Rs.* 30 million to *Rs. 240* million.
Almost two-thirds of software exports in the year 1986, worth 'Ra 360 million, were accounted for by two Tata companies-Tats Borroughs, Ltd., (now Tata Unisys) and Tata Consultancy Services. ifowever, other computer companies such as ICL, Wipro, IBnditroq '~eiAth and Sonata have recently started selling software packages 'is11e'velnped in-house and tailored to the Indian market. Wipro's

ag1'tojecYmanagement package "Instaplan" and Sonata's word pro 'L'beor "WordLord" are seeping into the world market. The target for `_'f~bJtpbhta in the terrrtinal year of the Seventh Plan set by the Depart ment in the Electronics is Rs. 3 billion, of which Rs. 2 billion is targeted to be achieved from the export of system engineering and consultancy services

Microelectronics

The basic strategy which India has adopted in this area is to 'brsildhp :Capability and capacity to design and develop (and, where necessary, also to purchase appropriate foreign designs) and produce 'M9 is9htigktoin and eustan "chips" needed to meet domestic needs In all the market segments while buying the cheaper multisourceable stander LSI/VLSI chips in the world market.[10]

The public-sector company Semiconductor Complex Ltd.(SCL) was set up by the government of India to be the leader in this area. concentrating on Metal Oxide Semiconductor (MOS) type chip technologies. SCL started by concluding a technical collaboration 'fQeement with American Microsystems Ins (AMI) in 1951 fox the purchase of fivo-micron CMOS and NMOS Largescale integrated (LSI) chip technologies. Over the five years ending in 1986, SCL has been able to-achieve full vertical integration in such chips, from computer-aided design (CAD) to mask fabrication, wafer fabrication and packaging. A major R&D effort mounted concurrently with the collaboration agreement with AMI has enabled the company by mid-1986 to suceed in developing its own 3tnicron VLSI (Very *lard* Scale Integrated) chip technology. Using these processes, SCL now produces timekeeping circuits, telephone pulse dialers, microprocessors and associated peripheral chips and advanced telecommunication chips like codecs, line drivers, etc. SCL plans to develop 2•micron and 1.25-micron VLSI/ELSI chips by end-1988 and end1990 respectively.

Another public~ector company, Bharat Electronics Ltd. (BEL),

Developing country Perspective

has built up the capability to produce and design chips based c Bipolar Integrated Circuit Technology and is therefore complementat to SCL.

Concurrently, R&D work on various aspects of microelectroni$_c$ has also been promoted in leading research institutes such as th Central Electronic Engineering Research Institute and the Tat Institute of Fundamental Research, as well as in higher educationa institutions such as the Indian Institutes of Technology and soma universities. Many of these programs also havea significant man training and skill formation component in them.

To plan, program, coordinate and generally oversee the microelectronics program as a whole , the government

LSI/VLSI design at hi g P a series of Cad laboratories and ghee educational institutions, R&D Ponies such as ITI analog electronic equipment manufacturing com

nd ECIL Several R&D projects are also being planned in the complementary area of process technology for producing newer *types* of chips in the country's two "silicon foundries," SCL and BEL.

Systerrt Capability

The core of the impact which infestation technology make on development is the use of rote acted

[tel]ecommunication s g5' can

systems to convert ~ computer-cum use/manipulate/control such information for planninfo~ation and making, efficiently managing large economic g and decision

productivity and safety, and imp or ' assets, enhancing

access to new services, in areas such ~ the availability, quality and and even telecommunication itself. It is~lthes~yeducation, health

develop, engineer, integrate, install, co Paucity to design, maintain such IT-based systems that India has built u support and capability. p an impressive
In the civilian sector, government agencies like the National Informatics Centre (NIC) and a whole range of public sector com
ponies like ECIL, CMC Ltd., the Telecommunication Consultants EndcaLt B (~~~)' the Railway Industrial and Technological

gingering Se (RITES) Ltd, and Gujarat Communications and
d
Electronics Ltd. (GCEL) have built up considerable capability over the last seven or eight years in advanced informatics/telematics systems and have undertaken major projects involving such systems in key sectors of the economy. These companies have the resources, including project management skills, to undertake large turnkey projects, from definition of the information needs of the user/ customer to customer training and support services. What is more, this has been done in both centralized and disMbuted data acquisition and processing environments. A few companies in the private sector, such as Tata Consultancy Services and Processor Systems
India (PSI) Ltd., also have some capabilities in this key area.
Summary accounts of specific systems already completed or
being executed in various sectors of the economy are given in the
following section.

InformaHts-bssed Systems in Major Economic Sectors *Government*

The National Informatics Centre (NIC) was set up by the government of India in 1977 as a constituent unit of the Department of Electronics to play a promotional role in creating appropriate computer-based information systems in government agencies (or planning and decision making. NIC provides services to its user departments through a number of application divisions, which arc responsible for conducting feasibility studies in the user departments, designing and setting up appropriate information systems, creating awareness of computer use as a tool (or decision support, and developing Management Information Sytcms (MIS)." These divisions are organized around the following sectors: Finance, planning, agriculture, water resources, human resources, industry, commerce, energy, health, urban development, rural development, steel and mines, communication, broadcasting, science and technology. law, external affairs and home affairs. As a result of sustained efforts over the last decade, NIC now provides IT services to all the fifty-nine civilian departments of the government of India.
Feasibility studies and Then the actual computerizatirnr of excise duty assessment, income tax, customs clearance. and import and export data have been carried out by CMC. ECIL, Tata Unisys. Tata Consultancy Services. WiDro Information Technology. ORG Systems and many other organizations under the auspices of NIC."

Concomitantly, a District Information System covering all state capitals and districts is being planned." This has been made possible due to recent advances in distributed data processing techniques and the availability of relatively powerful computer systems in the form of PC-ATs and super-ATs at low prices. The District Computer Centres (DCCs) will have databases relating to district information, such as village profiles in terms of education, health, occupational patterns, major economic activities and their cha2etetistics, employment, etc. The DCCs will also collect and process data for the monitoring of major development projects included in the five-year plans of the district and of national programs such as the integrated rural development *program,* the national rural employment program and the rural landless employment guarantee program.

Banks

Computer-Assisted Ranking (CAB) is a sensitive subject in India, because it is the largest

single area of office automation and because of the implications of such automation for employment, both present and potential. R involves four parties; the bank management, the labor unions, bank customers and the government. The government has great interest in chalking out a program Cor the speedy computerization of banking operations. The bank management, on the other hand, has not fully appreciated as yet the real advantages and disadvantages of computerization. The bank unions have considerable muscle, and a bank strike is a powerful weapon. Bank customers want improvement in the quality of service, particularly speed.

CAB operates at various levels: check clearing using Magnetic Ink Character Recognition (MICR), internal networking (linking various departments of a particular branch, as also intrrcity and intercity branches of the same bank), external networking Clinking it with either the Reserve Hank of India, the central bank of the country, or with other institutions outside the bank), MI5 and other customary internal applications (employees` salaries, benefits, budgeting, inventories, cash book, eteJ, customer aids such as Auiomafic Teller Machines (ATM), customer interface terminals. ate., and specialized applications such v linking with the Society Cor Wodd-wide Interbank Financial Telecommunications (SWIFT).

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In September 1983 the Indian Banks Association (IBA) and two employees' unions reached an agreement to install computers in areas which do not affect the manpower requirements of banks." These were statistical database generation, credit card usage, transfer of remittances, foreign exchange transactions, management information systems, budget control, personnel inventory, salary and provident fund, merchant banking, and intmbranch and interbank reconciliation of accounts.

Meanwhile, the government , in its bid to speed up computerization, had set up a committee

to identify areas where computers were essential. In a report submitted in January 1985, the committee identified the areas of operation where computing could be introdoted in a phased manner. An outlay of Rs. 1.34 billion for the years 1985-87 was also provisioned.

The committee spelled out the computerization program needed at all three levels of the Indian banking system, viz., branch, regional, and head office. It was proposed that initially, 25 mainframe computers, 200 large microcomputers and 10,000 Electronic Ledger Posting Machines (ELPM) be installed. The manpower requirement to handle the task was estimated at 45,000 operators and over 1,000 systems analysts.

The Reserve Bank of India (RBI), which coordinates interbank clearing, introduced computers in Bombay in 1984 and later on in other metropolitian cities which account for nearly 55 percent of the approximately one million checks cleared every day. Computers have brought down the time spent in balancing accounts from four hours to fifteen minutes per day. But check clearing continues to take two days for local checks and more than ten days for outstation cheques. The RBI and IBA have both decided to rectify this by introducing MICR machines on a large scale. This was done in 1986-87, and regular clearing operations using MICR will become operational by the beginning of 1988-89.

The most decisive factor in computerization in banks has been the willingness of the various employees' unions. At present, unions have agreed to install a maximum of 3,500 computers by September 1987 for front-line operations in branches handhng 1,000 vouchers or more per day." This will cover about 1,200 branches. The unions have also agreed to allow the use of machines of memory capacity up to 256 KB for banking operations in the branches. N
return, the IBA has offered Rs. 350 per month as a special allowance to employees handling such machines, The bank management however, are keen to install 2,500 additional machines befm September 1988, and another 2,500 before September 1985
covering about 4,800 bank branches in three states."

Power

The Primary task of a power utility is to deliver power tc consumers with confinuity, security and quality at optimum prices This requires modern energy management tools and facilities at the load despatch centers so that a vast amount of dynamic power system data spread *over a* large geographical area is available in time at the control centers for taking critical decisions on operating strategy.

The load despatch system incorporates a modern energymanagement system1° involving the on-line acquisition of power system data and its real-time processing by computers. The system consists of the following subsystems:

a) Data acquisition subsystem: To acquire the current status
of the electrical power system using suitable transducers.

b) Communication subsystem: To[co]mmunicate/transmit
the status parameters of the power system to various levels in the control hierarchy. Both data and voice communication are involved, and communication is usually based on a combination of optic fiber, satellite, UHF and VHF communication systems.

c) Computer subsystem: For processing the data acquired and transmitted. Provides powerful distributed processing along with dual computer systems to enhance system availability. All computers [ar]einterconnected.

d) Man-machine interface: Cives despatchers relevant information in a complete, coherent and comprehensible form. It also provides the means to modify data and analyze Processed information.

Such a system enables better monitoring, control, and management of power system resources, better load management, safer and secure power system operation, prompt p[r]eventive/corrective action by operators, better adherence to system frequency and voltage, an optimum scheduling of generators, and a reduction of transmission losses.

So far, computer-based load despatch facilities have been established at the Regional Load Despatch Centres (RLDCs) in the northern, westem and eastern regions and at the State Load Despatch Centres (SLDC) of Maharashtra State Electricity Hoard (MSEB). Certain minimum facilities have been provided at the other SLDCs in the western and eastern regions.

However, a major program to induct SLDCs in several other states is now under way. ECIL and CMC are the principal systems suppliers.

Oil and Gas

With the discovery and rapid exploitation in the mid-1970s of the offshore oil fields in Bombay High and Bassein, 200 Mlometers northwest of Bombay, the Oil and Natural Gas Commission (ONGC), the nation's principal agency (or crude oil exploration, proving and production, decided to set up an integrated telecommunication-cumcomputer-based telemetry and remote telecontrol system for its offshore production platforms and associated onshore gathering, processing and distribution systems." This complex project was originally proposed by ONGC, to be undertaken on a turnkey basis by a foreign contractor. However, at the instance of the Department of Electronics, a special project group was set up comprising experienced communieationeumcomputer speeiahsts from the nation's air defense organization. The first phase of the total program, covering 6 offshore platfomts, was completed in 1981 at a total cost of Rs. 30 million, compared to the Rs. 100 million quoted by foreign contractors. Over the last five years, the second phase, covering another 21 platforms, has been similarly completed at a cost of Rs. 120 million. Work is now under way on the third phase, covering a further 50 platforms (77 in all), at a total cost of Rs. 250 million. The entire network, to cost Rs. 400 million when completed, has been designed, engineered, produced; installed, sof[war~genetated and implemented without any foreign involvement The configuration of the systems involved in this project, called TITAN (Telecommunication, Instrumentation and Teleeontrol in an Automated Network), is shown in figure L It has been estimated by ONGC, after operating this highly sophisticated system for around five years now, that it has enabled around 5-7 percent more oil production offshore through better field management, tighter controls, and better optimization of production and processing.

Steel

The Steel Authority of India (SAIL), which is practically the whole of the Indian steel industry, has decided to introduce a Rs. S billion Integrated Process Control and Management Control system.' Phased over five years (1987-92), the system will involve installation of sensors, terminals, computers and a large communication system.

Highest priority is being given to energy-saving programs, including a combustion control system for coke ovens, soaking pits, reheating furnaces, stoves, boilers, etc. Also, computerization of the following scheduling operations has been started in early 1987 and is to be completed within three years: gas despatch systems, power scheduling, scheduling of locomotives and wagons, soaking pit scheduling, and tracking of products to avoid mixing.

In addition, microprocessor-based weighing systems will be installed in cranes, hoppers, belt conveyors and platforms. Personal computers will be made available to shop superintendents in the steel plants to manage shop activities and maintain statistics for raw material consumption and steel production. Similarly, PCs and work stations will also be provided to carry out day-to-day activities relating to finance, purchase, stores, project monitoring, marketing, etc.

At present, computers in the various steel plants and in SAIL headquarters at New Delhi are connected using hotlines from DoT. These lines will be augmented by installing digital exchanges with the capability of communicating voice, data and facsimile. SAIL will also switch over progressively to a satellite communication system using micro earth stations working with INSAT over 1988-90. The total plan involves an integrated data network using satellite circuits, terrestrial data circuits and radio links to connect stockyards, branches, zones, regions, and plants with the corporate office.

SAIL will also standardize its software, including operating systems, communication protocols and database packages, for smooth operation among different systems. The whole activity is being coordinated by a team at the corporate office and at each plant location.

Railways

Practically every nation operating an airline has gone out and bought a mufti-million-dollar airline reservation system from the market. In contrast, railway reservation systems are relatively un known. They have to handle a much larger transaction volume, deal with far *more* complexity, serve almost a hundred times as many locations, and do all this at a much lower cost per transaction. For example, the railway reservation system now operating in Delhi handles 7 classes of accommodation, IS types of quotas and 75 types of concessions and performs considerable waiting list management for most of the 700 trains that leave Delhi every day." It handles 45,000 transactions per day through 175 terminals spread over the city. It is inconceivable that an international product could have been easily shoehorned into this job.

A few aspects of system design, such as providing for 99 percent system availability and fast response time, are common to all similar applications. Practically everything else is highly customized - for instance, the fact that the tickets being printed in Delhi are in Hindi as well as in English. Also, a very close interaction with the railway management and training of a large number of railway staff was involved. This was very manpower-intensive and would not have been cost-effective with foreign manpower, particularly if it had been from industrially advanced countries.

The approach to this project (which was undertaken by CMC Ltd.) was very practical, and in some ways conservative. Recognizing that the percentage of cost involved in hardware is not all that high, very good stateof-theart hardware was purchased from international sources. However, the complete system design and engineering, project execution, training, maintenance and updating - and above all, all the software design - was done in India.

An important feature of this experience was the ease and speed with which this job was done, as well as its totally successful outcome. The Delhi system went on-line in 24 months, including training of the railway booking clerks. At a total installed cost of Rs.120 million, it has been far cheaper than the price quoted by foreign companies. As a result, similar systems are being introduced by CMC Ltd. for the other three metropolitan hubs of the Indian Railways, viz., Bombay, Calcutta and Madras. However, this is only the beginning, as there are several hundred major railway stations and a total of 7,000 stations in the Indian Railways network.

While the railway reservations system contributes to improved service to the 100 million Indians who travel by train every year, freight management has a far greater economic impact. There are on the order of 11,000 trains and 240,000 railway wagons operating on the Indian Railways every day. The capital investment of several billion dollars made in the railway network is exploited only to the extent that wagons and locomotives are efficiently managed and optimally used. Further, freight movement plays a very critical role in the economy, as wagon shortage can cause severe bottlenecks in the movement of foodgmins, POL, industrial raw materials, and intermediate and finished products.

A three-tier system has been devised to meet the needs of operations at different levels of the railway network - central, zonel and local." The central tier is to run on a very large mainframe of the IBM 3084 class, while the zone! tier, involving seven zones, is to run on large super minicomputers. The local tier is to consist of some 3,500 terminals at loco sheds, marshalling yards and local freight nodes. Network design is now in progress, and the system is to be operational by the mid-1990s. With a budget of around $ 400 million on the computer segment and around $ 700 million on the communication segment, few projects in the developing world (or perhaps even in the industrialized countries) pose a technical challenge of such dimensions as this project.

Telegraphy

As noted earlier, the fraction of the population covered by telephone service will remain very small until the year 2000, when 20 million phones will serve one billion people, mostly in the urban areas. This situation prevails in almost all other developing countries as well.

Therefore, these countries cannot afford to allow telegraphy to die out. Instead, they must improve it, using modern information technology: A major means of doing sob to apply the techniques of computer-based message switching to telegraphy.

The challenge is tremendous, as there are in India over 20,000 telegraph offices, of which 450 are at district headquarters alone. Message-switching computers have not reached even all district headquarter towns. The real challenge becomes clear only when we consider 600,000 villages and visualize at least a quarter of these getting reasonable communication facilities.

There are a number of technological options open, offering attractive possibilities. One is the use of facsimile, providing for multilingual communication. Another is use of bilingual terminals. Still others involve the use of satellite communications, dial-up communication over the telephone network or the use of VHF(UHF, combining a packet switching data network with telegraphy.

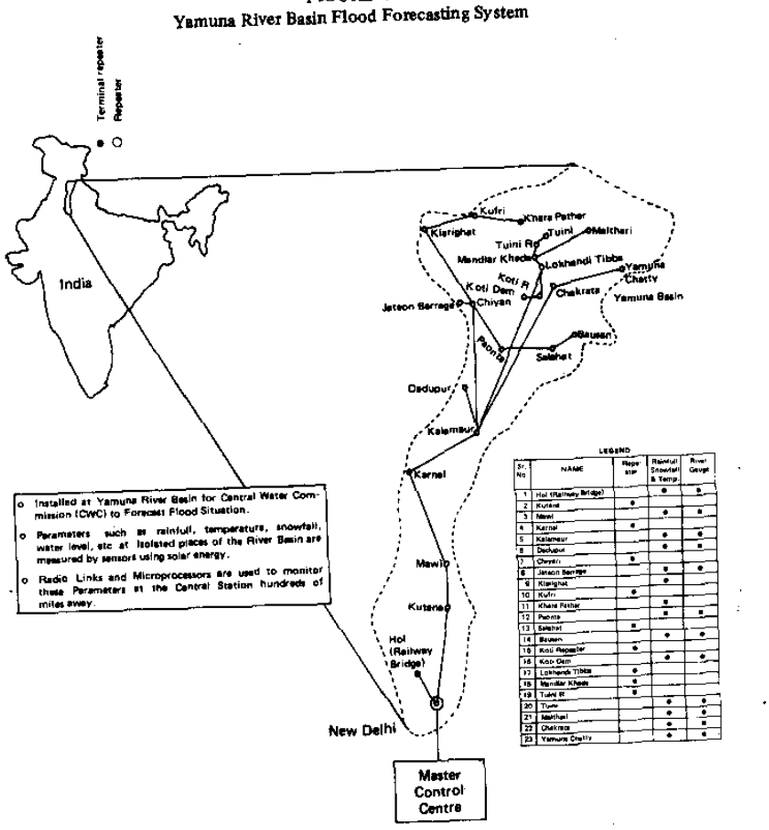
Against this background, a pilot project on a microcomputerbased, message switched, electronified telegraphy system is under design for the northeast of India. Micro satcom terminals working with INSAT will constitute the transmission backbone. The system is to be operational in 1990.

Hydrology

The Yamuna River is one of the major rivers of North India. Its waters play a key role in both agricultural and human settlement water supply in the region. The water sources of this river are the numerous rain catchment and snow-melt areas in the upper Himalayas. Obtaining information on the flows of water into the *river* from these locations, particularly in the spring, is of *great* importance to planning irrigation releases, industrial consumption and human settlement consumption in the tower reaches of the river. Data on such meteorological parameters as ambient temperature, atmospheric pressure and humidity is of great value in predicting rainfall intensity and geographical distribution during the monsoon months.

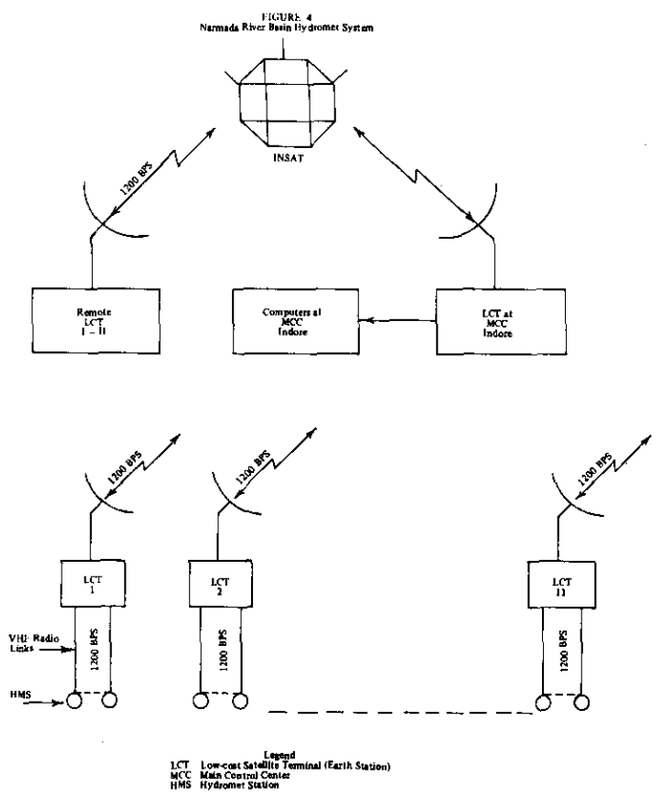
To meet these requirements, the designn of a hydrometeorological and flood forecasting system for the Yamuna basin was initiated in 1981." The system finally implemented covers over 400 squares kilometers of the river's catchment area. Hydromet data is collected by automatic sensors at 23 unmanned stations (7 above the snow line) and transmitted to the master control center at Delhi. The radio links involve two-way *VHF* transreceivers, multirouted to ensure high reliability. Each remote station consists of sensors, a microprocessor-based slave teleprocessor and a radio transreceiver. The master teleprocessor at the control center sequentially interrogates each of the slaves and acquires data from the various sensors - temperature, pressure, rainfall snow melt, river level. All the remote stations are powered by solar photovoltaic power resources, so that fossil-fueled energy sources, with their attendant problems in such envIronments and locations, are eliminated. A schematic of the system is shown in figure 3.

FIGURE 3
Yamuna River Basin Flood Forecasting System



Concurrent with the setting up of this large system over the
1981-85 period, the operating agency, the Central Water Commission, in collaboration with local computer groups and specialists from the World Meterological Organization, also developed computer models of the Yamuna River and the pattern of rainfall and snow melt. Associated application software for processing the fieldcollected data and fitting it to the model has also been developed. The whole system, executed for a cost of $ 4 million, was done by Indian organizations and has been in regular operation since the spring of 1985.

Based on the by now proven utility of such hydromet systems, a much larger system covering the basin of the major central Indian river, the Namuda, which flows through the states of Gujarat, Madhya Pradesh and Maharashtra, is now in an advanced stage of design. The task is being undertaken by the public-sector companies CMC Limited" for the computer segment and Telecommunication Consultants India Ltd. (TCIL) for the communication segment. The basin being 600 kilometers by 400 kilometers in size, the Narmada hydromet system is being designed on the basis of low-cost satellite communication terminals (LCTs) INSAT. As the system invowes a number of dams for power generation-cum-irrigation, the computer segment is much more complicated than for the Yamuna basin, with a multilevel system architecture involving micro, mini, and super mini computers. An outline schematic of the *system,* expected to be fully operational in the early I990s and to cost around $ 20 million, is shown in figure 4.



News Media

The Press Trust of India (PT!), the nation's premier news agency, has had a very successful experience in developing a commercially viable service in information technology under the pressure of the Ninth Asian Games held in New Delhi in 1982. PTI had always wanted to start a VDU service which would give special end-user groups instantaneous access to information being constantly updated As a first step, PTI decided to try out a very simple, noninteractive scheme not involving modems, etc. The NEWSCAN" concept is the use of 50-baud teleprinter channels and circuits to feed display units at customer premises such as airports, railway stations, hotels and office lobbies. In comparison to a teleprinter pouring out meters and meters of paper, the system elegantly displays messages so that twenty to thirty people can comfortably read what is being displayed.

The display unit consists of a microprocessor-based controller and a TV monitor. At the PTI office, a microprocessor-based editingcum-dissemination unit called EDITRON is used to generate and sequence the news capsules. The EDITRON, as also the controller for the NEWSCAN system, was designed and built by PTI's R&D staff. The whole system makes no special demands on the telecommuni cation system at all, as 'good old" teleprinter channels are adequate for transmission. The EDITRON stores up to 20 items (each limited to 14 lines of 40 characters) and cycles them repeatedly. A reader walking up to a display may spend thirty minutes before he sees a repeat. As new stories become available, the staff operating the EDITRON deletes old items from the cycling list, enters the new items edits them on a VDU and releases them for dissemination. A very logical extension of the system is to make available the video signal from the controller to the closed circuit TV systems of, for example, hotels, making PTI news available round the-clock in every room of a hotel as one of the TV channels. The hotel itself will receive the news through a teleprinter cable, but the display controller will convert this to a standard TV signal for *feeding* the closedcircuit network.

PTI is now moving on to an interactive VDU service, where the experience gained with the simpler EDITRON will be valuable. It is worth emphasizing that NEWSCAN is a commercially viable service now, not just a technical experiment.

The Information Dissemination Editing, and Switching System (IDEAS) is an on-line, real-time message switching system for handling news *agency* operations at one or more primary nodal points in a geographically distributed communication network of a news agency. such as PTI."

PTI has a network of leased teleprinter lines interconnecting its various bureaus. The bureaus situated in metropolitan cities - Delhi. Bombay, Madras and Calcutta function as editing bureaus and are also interlinked through 4800-baud data circuits. Each editing bureau is connected by two way lines to several subregional centers of PT[under its jurisdiction. Subscribers *receive* news from the regional bureaus, and those in the metropolitan cities from the editing bureau itself.

A team of professionals from the National Centre for Software Technology (NCST) and CMC Ltd, worked for over eighteen months to put IDEAS together, taking into account PTI's needs in full. The team worked very closely with PTI's professionals to obtain application-specific knowledge. The participation of PTI's professionals in the planning stages has provided a high degree of satisfaction in meeting functional requirements.

Multilingual Aspect

The Constitution of India recognizes fourteen languages besides Hindi as the official language and English as the associate language. Until the early 1980s English was the sole language in which computerization was undertaken. However, since then, the government has been actively promoting the use of Hindi and other languages.

Basic Approach

The basic approach adopted for providing what is essentially input-output capability in Indian languages for computer systems has been to design coding schemes and to develop and produce add-on hardware and software. The work plan has involved the following areas

a) Development of a coding scheme for Indian scripts.
b) Design of keyboard layout for Indian scripts.
c) Design of hardware for terminals supporting 1/O in Indian scripts.
d) Design of fonts for display/printing for Indian scripts.
e) Providing software support for printers for Indian scripts.
f) Development of software for specific applications support, such as DBMS, compilers, etc.

The terminals developed using the above approach can then be connected to any computer system which can support the coding scheme used for Indian scripts. As for software, the scheme has been evolved in such a way that standard software packages available in most computer systems can be used directly for Indian script processing.

Coding Scheme

A new coding scheme called the Indian Standard Code for Information Interchange (ISCII) for developing an input-output system for Indian script processing has been developed.[°] This ISCII code is the ISO-compatible extension of the 7 bit ASCII code to 8 bits This code is implemented by overlaying a phonetic structured inscript (Indian script) on a standard keyboard in such a manner that the standard ASCII code is not disturbed.

A common characteristic of all Indian scripts is that they reflect phonetically structured languages. This characteristic has been used to design a common keyboard layout for all Indian scripts.

Products and Software

There are two basic elements here: (i) Indian script-based terminals which can be connected to any computer system supporting ASCII character set, and (ii) software usable on PCs for Indian script processing. Prototype multilingual word processors and computers operating in the Devnagd script of Hindi have been developed by CMC Ltd. and ECIL in the public sector, Tata Consultancy Services and DCM Data Products in the private sector, and by the NCST and the IITs at Kanpur and Madras in the R&D sector. Such products are now under regular commercial manufacture.

As for terminals, the Graphics and Indian Script Terminal (GIST) developed by the LIT at Kanpur provides the capability for operation of I/Os in the scripts of five languages - Hindi, Bengali, Tamil, Telugu, and Marathi. This technology was licensed to several companies in 1986, and commercial products have just started coming into the market."

With regard to software, a major target is developing multilingual packages for computer-aided instruction under the CLASS Program. Several companies and laboratories are currently working on this. Work is also under way to develop distdct4evel databases for the NICNET program in the Devnzgi script of Hindi.

The facilities thus developed are proposed to be used also for Indian script-based telematics services in the future.

Information Networks Dedicated Networks

Networks dedicated to particular users are coming up in a big way in the country.

The Oil and Natural Gas Commission (ONGC) has decided to install an integrated communication network at an estimated cost of Rs. 140 million to serve its operations in the western region 3^0 The proposed network will not only provide general voice communication, but also telemetry cum-telesupervisory communications for the flow of oil and gas.

ONGC is also setting up a network acronymed TELNET to provide long-distance voice communication, to interconnect computers at corporate and regional headquarters, and to provide low-speed data transmission. This is to be done using 12 dedicated channels on INSAT. The nodes will be located at Dehradun, Bombay, Madras, Calcutta, lorhzt and Baroda. This network will be used mainly to handle the large volumes of seismic data being generated at the exploration sites. The estimated cost of this project is Rs. 160 million."

ONGCs future plans include implementing local area networks and teleconferencing.

Coal India Limited (CIL) is also planning new measures to increase the utilization of capital investment, giving greater returns.[32] Measures to be undertaken include better deployment of manpower and equipment, increasing production and making transportation more efficient, besides facilitating quicker management decision making and safety. The program is being implemented in two parts - a terrestrial telecommunication project and a satellite communication network. A point to-point network between the corporate head-

quarters been ocommissioned. In phase I of the satellite communication plan. already cation plan, 10 earth stations are proposed to be set up.

The Central Electricity Authority (CEA) has also decided to plan an integrated telecommunication network" exclusively for the power system. The proposed mision, radio systems and fiber optic links. To meet operational requirements, the network will link the National Load Despatch Centre at Delhi, the five Regional Load Despatch Centres (RLDCs) and all the State Load Despatch Centres (SLDCs)

In large states, for economy and operational convenience , subload despatch centres will be established. The n t lecront will o support speech, telemetry, telesigraling, teleprojection and facsimile transmission. was launched

The Education and Research Network (ERNETand application

by the Department of Electronics as a technology

development program in the area of computer networking and

telematic sevices during the Seventh Plan" The procam envisages establishment of a nationwide network, ERNET, to link computing

resources at academic and research centers in the and demontmfion

as a vehicle to undertake technology

of concepts relating to computer networking and new telematic services. computing services available at In the first phase of ERNET, leering educational and the Indian Institute of Science ein Bangalore Institutes of Technology, in Bombay, will be and the National Centre for Software Technology put on the network. in each of the Local Area Networks (LANs) will also be setup participating institutions. Computing equipment at locations at a radius of 10 kilometers from each other will be connected over VHF, UHF and microwave links in atoMesetpupti dedicated Area aetcommuMAN). Other users planning planning include the Indian networks, principally for informatics functions, Railways, Indian Oil Corporation, Gas Authority of India Limited, Bharat Petroleum Corporation Ltd., National Thermal Power Cor poration Ltd. and several banks.

Integrated Public Networks

INDONET is a project launched by CMC Ltd. It comprises a network of computers located in many cities and connected by data communication links. It is aimed at providing contemporary distrib uted computing facilities to as large a segment of the country as possible. The network has been designed not only to support public data communication, but also to meet the requirement for a nationwide public data processing utility with sophisticated applications software and program development capabilities. It provides transaction processing, operations research production planning and project management software, graphics and database management facilities and numerous packages developed by CMC for yanking, industrial and financial organizations.

The Phase 1 configuration of INDONET shown in figure 5 has been operational since March 1986. It consists of computer centers at Bombay, Calcutta, Delhi, Madras and liyderabad, together with access points in Bangalore, Ahmedabad and Pune. The present INDONET computing power consists of three IBM 4361, INTEGRA 1001. and DEC PDP 11/44 computer systems. The computer centers and access points are connected by dedicated data lines from the Department of Telecommunications at 2,400 or 4,800 bits per second

This phase is based on IBM's System Network Architecture (SNA). The access to INDONET computers is possible from CMC computer centers or through the use of terminals at customer premises via dialed or dedicated links. The intracity links can operate at a speed of 12 kilobits per second. The major limitations in this phase are low data transmission speed, limited processing power and inflexible switching units. These bottlenecks have resulted in slow response time, even with the limited communication services offered by the network.

Phase II of INDONET is likely to be completed by the end 1988. The configuration of Phase II is given in figure 6.

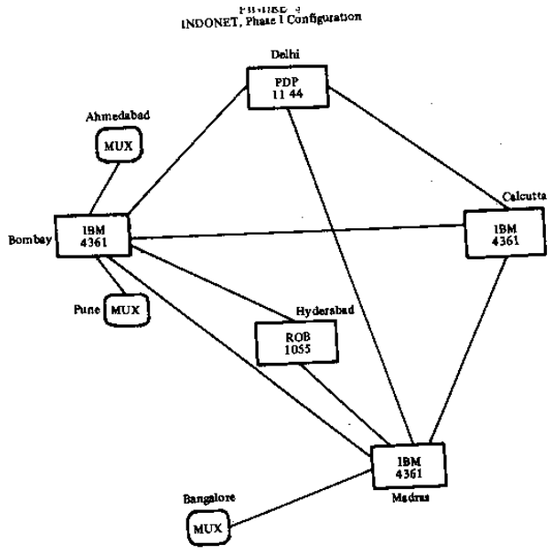
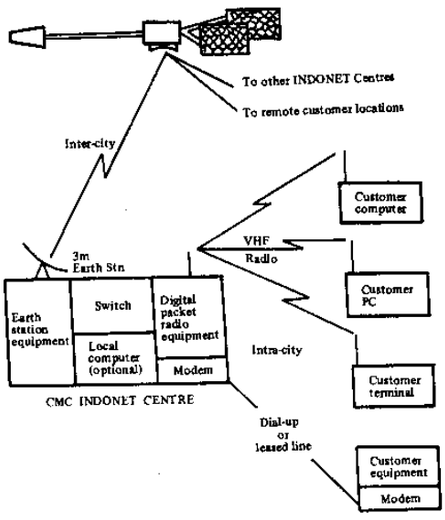


FIGURE 6
INDONET, Phase II Configuration



In phase II, intercity communication will be via satellite. It will operate as a STAR network with the control points at New Delhi. By 1990 the number of INDONET centers is expected to grow to 100. The remote customer locations will use rooftop mounted, threemeter, low-cost satcom terminals (LCTs) being built by ITI and ECIL. A packet switch at the central station will switch data addressed to other centers. Transmission from both center and remote stations will be at 64 Kbps, i e. fifty time faster than in Phase I.

In this phase, the network is expected to permit access to user terminals and computers of organizations in the areas of banking, transportation and mining.

CMC plans to use a packet radio network to avoid the "last-mile problem." Flexible low-cost micro satcom terminals make this system cost-effective and significantly faster (at 9600 bps) and more reliable than current local communications.

INDONET will also be connected to public data networks in other countries through the international gateway switches and satellite earth stations of the Overseas Communication Service. This would allow access to data bases abroad and the development of computer software for export.

The National Informatics Centre Network (NIC-NET)[°] was initially established as an intracity computer network in Delhi eonsisiting of IS computer systems and 35 interactive terminals

located in various government offices, connected to a large CYBER 170/730 computer sytem. NIC has installed over 200 PC-AT and PC-XT compatible systems in various ministries and departments in Delhi. In important government buildings, these PCs have been connected as Local Area Networks (LANs), which in turn are connected to the NIC main system through DoT-leased circuits.

In its second phase, NIC is expanding NIC-NET to cover all state capitals and district headquarters for planning and monitoring and for providing a quick information link between the state and central governments.

Each of the 438 district computer centers will have a super-AT system for providing services to the district administration, as well as for gathering information on the monitoring of development projects and other socioeconomic data required by the state planning agencies and the central government.

As a part of this program, four large S-1000 mainframe computers from Nippon Electric Company (NEC) of Japan have already been installed in New Delhi, Bhubaneshawar, Pune and Hydenbad. Super minicomputer systems ND-550, made by ECIL, will be provided to the state governments to act as a bridge between the central system and the district system.

NIC-NET will use satellite communication for connecting district and state centers to all the regional centers in the country. The main earth station will be installed at Delhi, with micro earth stations in state capitals and district centers. NYC-NET will use INTELSAT-5 in the first instance and later switch over to INSAT-1 C when it becomes operational in mid-1988. Microwave and other terrestrial communication links will also be used for the intercity network where required

The Local Area Network connecting PCs located in important government buildings in Delhi will have external gateways for linking to the NIC NET. A similar pattern will be established in the state capitals NIC-NET will also provide a gateway for accessing i$_{n}$t$_{er}$national databases.

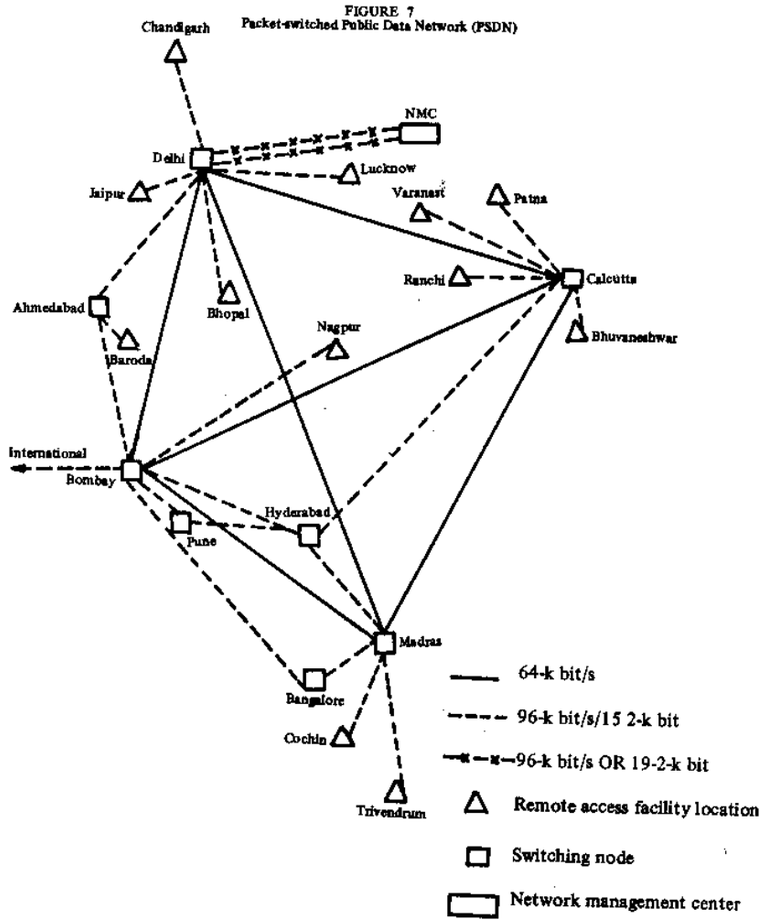
Packer-switched fttblic Data Network (PSDN)

This network (VIKRAM) will provide data switching capability for various types of applications and as a transport mechanism for telematics services, mainly videotex, teletex and electronic mail.

The Department of Telecommunications (DoT) established an experimental three-node PSDN Delhi, Bombay and Madras - in July 1986 based on locally developed software.[s'] Services provided in this PSDN included message transfer, interactive computer access to remote files/databases, and computer computer communication.

The network topology envisaged for VIKRAM is depicted in figure 7. Each node is connected to at least two other nodes. The network will initially be equipped with a Network Management Center (NMC) located in Delhi and connected to the Delhi switching node through duplicated 9.6 Kbps modems as an X.25 device. The Bombay node will also work as an international gateway and will handle all originating, terminating and transit international traffic, using both terrestrial and satellite links. The four major nodes in Delhi, Bombay Madras, and Calcutta will be mesh-connected, and the communication between these nodes will be at 64 Kbps. Other nodes as well as remote access points will be connected at 9.6 Kbps.

FIGURE 7
Packet-switched Public Data Network (PSDN)



The network will use both terzestrial and satellite channels and would support packet switching interface to CCITT's X.25, X.28, X.29 and X.75 protocols. The network will have facilities to overcome line failure, hardware failure and congestion at nodes.
The network will provide statistical and accounting information so as to monitor the activity of calls, lines, switching nodes and remote access facilities.

TCDC Project INTERACT

International Education and Research for Applications in Computer Technology (INTERACT) was a project supported by the United Nations International Fund for Science and Technology for Development (UNIFSTD) and the government of India, under taken by CMC Ltd.[7°]

INTERACT was undertaken over 1981 -84 as a TCDC program in which professionals from various developing countries worked together and shared their knowledge and skills. The objective of the program was to develop and transfer technical knowhow for system engineering of real-time, on-line computer-based systems dedicated to development-oriented applications. The scope of the project included analysis, design, development and realistic testing of real-time and dedicated computer-based systems.

The application areas chosen for technology development were power system management, meteorology (image processing of data from weather satellites) and railway freight operations. Countries involved in the project included Kenya, Indonesia, Yugoslavia, Thailand, Venezula and Mexico. Both coprofessionals and trainees from most of these countries worked with Indian

counterparts at an R&D center in Hyderabad for periods ranging from three months to one year. The project has enabled participants to develop practical systems in each of the three application areas which could be implemented with considerable local expertise rather than as turnkey packages from foreign companies.

Perspective for the Future Telecommunications

progressively better telecommunication and telematic services by the turn of the century.

TABLE 4

Perspective Plan for Telecommunications

Item	1986	1990	1995	2000
Local telephone connections (millions)	3.2	4.4	9.5	19
Pudiccall ofticeaincities/towns	20	35	200	1,000
(thousands)	30	55	100	200
Telexconnectlons(thousands)	Few	10	100	800
Voice/data connections for business/industry (thousands)	32	43	100	600
Vlaages having public telephones or exchanges (thouands)				

SOURCE: Telecom *Misskw (i>aft A) Short Term* (New Delhi: Deprtment of Tdecom muni®Hone. 1987L

Overall telecommunication services needed by the turn of the century have been classified as follows:

a) Transport services. Voice, data, video, wide area access, local distribution access, local area access, LAN distribution and broadcast distribution.

b) Database services, text processing, data processing, image processing, rile storage, database access and teletext.

c) Enhanced services Packet switching, voice mail, electronic mail, encryption, personal number routing, store and forward switching, conferencing, control, monitor and alarm services, call distribution and protocol conversion.

Investments Needed

To attain the objectives of the Perspective Plan, the following investments are envisaged. 1985-1990: Rs. 60 billion 1990-1995: Rs. 150 billion 1995-2000: Ks. 290 billion Total: Rs. 500 billion

Computers and Software

The computer industry is going through yet another revolution with the coming of microchips such as 80386 and 68020/68030 from Intel and Motorola of the USA respectively. The introduction of such powerful CPU chips provides a quantum jump in the capabilities and cost-effectiveness of computers designed around them. Most applications in India will be based on computers designed using these chips for the next four or five years.

The availability of such microchips makes it possible to develop software techniques which would bring all the sophisticated software packages earlier usable only on mainframe computers into the range of microcomputer use.

Some efforts in this direction are under way in India. A project to develop by 1992 a prototype of a "fifth-generation computer system" with knowledge processing capabilities, parallel processing architecture and automatic programming has been initiated by DoE.

Similarly, projects in he area of computer-aided design, management and instruction, digital distributed control, etc., have also been taken up with the objective of bringing India into the leading group of countries in the informatics industry by the mid-I990s.

Implications for Other Developing Countries

As is well known, the developing countries constitute a group whose societies and economies vary widely in size, levels of education and health, levels of physical. and institutional infrastructure, character and composition of economies, and other factors. The utility of any new technology, such as informatics, for these countries will, as a consequence, also vary widely from country to country. Therefore, it is difficult to make generalizations. A diversity of goals and strategies is essential, indeed, inescapable;the implications for countries like Brazil, India or South Korea cannot be the same as those for Gabon, Paraguay or Vietnam. This becomes understandable when it is noted that informatics has come to occupy a position of importance in the highly industrialized countries only after the building up of highly diversified and sophisticated industriall and service sectors in the economies of those countries, and after human resources have become acutely scarce as compared to other factors of production, such as capital
and technological knowhow.
However, a few general observations can be made based on the Indian experience.
a) Policies and plans for using informatics/telematics should be formulated as an integral part of overall national development plans so that the types of informatics services introduced are relevant to the total socioeconomic context of the country concerned and are seen in the context of these activities.
b) Sectors where informatics can make a real contribution in terms of enhancing the productivity of the scarce resources of the economy concerned (not necessarily labor) should be carefully identified and applications promoted in those areas selectively. For example, if mineral development or tourism play key roles in the economy of a particular developing country, the potential of informatics to making those activities more efficient should be addressed first.
c) The application of informatics to improving the productivity of existing physical assets, whether the railways or other forms of transport or irrigation systems, should similarly be targeted as a priority.
d) The implications for employment and labor displacement of introducing an informatics application in an economic activity should be carefully assessed through appropriate social audits before the application is introduced.
e) Acquiring capability in systems design and engineering is the key to introducing appropriate informatics-based systems. Unlike in an electrical power plan, the hardware content in an informaticsbased system is much smaller than the software and support services involved. Success in this area calls for particular emphasis to be placed on the application involved rather than on the computers, communication equipment or other "black boxes" involved in the system.
f) Human resource development needs to be given a ***high*** priority, with an emphasis on the ability to apply informatics technology to local problem areas rather than on copying "packages" developed in the ***highly*** industrialized countries, despite the latter being more readily available.
g) The possibilities of building up capability and capacity in informatics through TCDC programs should be given priority so as to minimize costs and to seek out and develop technical inputs and modes applications which are more appropriate to the developing country concerned.
Notes

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CHAPTER 6

The Brazilian Informatics Policy

Renato Archer

The Brazilian informatics policy has been in effect since the middle of the last decade. It reflects some Brazilian peculiarities and perceptions and embodies many concepts and practices used by industrialized countries to promote their own development. It is based on legislation born of wide public debate among the various sectors of Brazilian society.
In order to describe this policy, it is useful to recall some of the conditions and background in which it was formulated.

Background

Brazil, with its 3.3 million square miles, is the fifth-largest country in the world. The gross national product approaches $280 billion, averaging an income of $2,000 per capita for its 140 million people.
At the dawn of World War II, the Brazilian economy was based on agricultural and primary products. The industrial sector was essentially limited to fields requiring low technology: textiles, clothing, etc. But during the war, the normal flow of manufactured goods and

equipment suddenly ceased.
As a response, the local entrepreneurs proved to be able to face challenges, developing and manufacturing new technologies and products. When the need for an adequate iron and steel industry emerged, in the absence of national capital and technology to meet the demand, a government-owned company was set up in 1945 which became fundamental to the industrialization of the country.
As for science, in 1951 a national council was established to accelerate and coordinate scientific research.
In the 1950s and 1960s Brazil undertook a major industrialization effort based on domestic entrepreneurship, both private and governmental, and on foreign companies. The goal was import substitution and the supply of infrastructural services. As a consequence, and for similar reasons, the government set up state-owned companies in oil, energy, telecommunications, transportation, etc.
During this process, it became evident that industrialization aiming only at import substitution was a limited objective which could not promote an authentic national capability to generate technology and innovations. It would be necessary to work toward achieving a complete domestic cycle of generation and use of technology if the industrialization process were to be consistent and selfsustaining. Aiming at this, the government embarked on significant efforts to enlarge and upgrade human resources, especially in engineering.
At the end of the I960s and the beginning of.the 1970s, the lack of an adequate capability to generate technology was strongly felt. A considerable number of Brazilian private companies with no prior access to the new technologies then appearing were being bought by foreign companies, which could introduce new technologies developed in their R&D centers abroad. Furthermore, government companies had to rely increasingly on foreign technologies. Thus the situation was one of growing dependency.
In the early 1970s, Brazil could count on a considerable number of highly qualified engineers and other professionals being produced by Brazilian educational institutions. But these professionals, mainly in the electronics sector, could devote little of their potential to R&D activities, since industry relied mostly on foreign technology.
Concerning the informatics sector, in the early 1970s there were already several foreign companies assembling computers in Brazil. The technology and the great majority of the inputs were imported. By that time, it had already become clear that informatics was going to pervade every activity of society and that, therefore, a high level of dependence on foreign companies and technologies was not desirable.
Thus, in 1974 a company was set up to manufacture minicomputers. Such a company was to be owned in equal shares by the government, by a private Brazilian group and by a foreign company, which would also supply the technology. It is worth noting that, in spite of efforts made by the government, it was not easy to find a foreign company interested in the deal.
In parallel, the government contracted Brazilian universities to develop hardware and software for a minicomputer and stepped up
its efforts to increase the number of researchers and skilled people in this field. The outcome of those actions proved essential to the development of the Brazilian informatics industry.
By the mid-I970s, due to the increase in the price of oil, Brazil, which was importing nearly 80 percent of its oil requirements, was constrained to cut imports. Among manufactured goods, computers were the third category on the imports list. A governmental agency, CAPRE, was

then entrusted with the analysis and decision making on every import licence request for computers, peripherals, parts and components.
CAPRE officials were conscious that such a control on imports was a powerful instrument of industrial and technological policy. CAPRE recommended that mini and microcomputers and peripherals should be areas reserved for national companies. In 1977, CAPRE selected three Brazilian firms to manufacture minicomputers by licensing technology.
In 1979, the Special Secretariat of Informatics (SEI) was created under the National Security Council and took over CAPRE's responsibilities. SEI promoted studies through special temporary commissions, gathering specialists to analyze a given subject and to present policy suggestions. From the experience gained through work in the field and from the propositions of these commissions, a coherent policy for the whole informatics sector emerged.
In March 1985 a new administration took office, and SE was placed under the newly created Ministry of Science and Technology, along with other agencies.

Informatics Policy Laws

The Brazilian informatics policy is based on two laws approved by the National Congress, namely, the Informatics Law, enacted in 1984, and the National Plan for Informatics and Automation (PLANIN), enacted in 1986.

The Informatics Law

The objective of this law is the development of the national infomratics capability to benefit the development of Brazilian society. It is based on several principles:
a) To ensure balanced protection for national companies
handling certain classes of goods and services.
b) To avoid the creation of monopolies.
c) To continually adjust the process of informatization of the country to the characteristics of Brazilian society.
d) To ensure to every citizen the right of access to correct information regarding him/herself which may be contained in public or private electronic databases.
e) To ensure a proper balance between the increases in productivity made possible by informatics and employment levels.
For the purposes of this law, informatics activities are those related to the rational and automatic treatment of information, specifically including:
a) Research and development, production, marketing, import, export and operation of machines, equipment and devices based on digital techniques and having technical functions, such as collecting, storing, processing, switching and displaying information; its electronic inputs and parts.
b) The same regarding software.
c) The same regarding microelectronics.
d) Structuring and exploiting databases.
e) Rendering technical informatics services.

National Companies

National companies are defined as those constituted and with headquarters in Brazil, whose control is in the hands of individuals resident and domiciled in Brazil or in the hands of national public entities. Control is understood as the sum of decision making (or managerial) control, technological control and capital control.
The law states that in order to ensure adequate protection to national companies while they are still unable to compete in international markets, the government shall adopt temporary restrictive measures concerning informatics activities. Besides these measures, the government shall encourage national companies with such instruments as:
a) The granting of financial and tax incentives.
b) The use of government purchasing power.
e) The adoption of international open systems, interconnec
tions and other similar standards.
d) Requiring that the interconnection interface specifications are in the public domain.
e) Technical support from government R&D centers.
National companies, in order to receive protection and benefits from the government, must commit themselves to the development of their technological capabilities and their effective use.
It is worth noting that all these restrictive measures are designed to be temporary and are in conformity with GATT rules.

Foreign Companies

It is expected that foreign companies dealing with informatics which want to set up a branch in Brazil should be active in leading-edge technology which is out of reach for national companies. This will ensure that the presence of these firms in the country will make a relevant contribution to Brazilian development.
Examples include IBM, UNISYS and the French-Brazilian joint venture *ABC-Bull,* which manufactures large-size computers. Ericsson, NEC and Siemens manufacture large-size SPC telephone public exchange equipment in Brazil. Foreign investment in informatics continues to flow into the country, as shown by IBM's recent $70 million manufacturing line of magnetic disk unifies (3380) for large computers, the new UNISYS large-size computer (A 15) manufacturing line, and the new *ABC-Bull* large-size computer (DPS7T2) manufacturing line. In the services area, a joint venture between a Brazilian group and IBM was recently established.
Foreign companies in the country are increasingly interacting with national companies in order to obtain more parts of their systems locally. As examples, we may cite a one-gigabyte magnetic disk developed by a national company in a joint project with UNISYS and now being produced by that company for UNISYS, as well as a similar effort by another national company and IBM concerning magnetic tape units.
It is clear that there will be always a role, and an important one, for foreign firms that wish to cooperate with Brazilian development in this field, provided they are willing to bring advanced technologies and fresh capital to our country.
The Importation of Technology
National and foreign companies may import technology. National companies, however, must commit themselves to the development of their own technological capability in such a way as

to contribute toward the development of the next generation of that technology. What is to be avoided is the continued and successive acquisition of technology of the same kind by the same company.

Table 1 lists some examples of technology bought by national companies.

TABLE 1

Types and Sources of Imported Technology

Product	Technology	Source
Super Minicomputers	Bull	France
Data General	USA Digital	USA Formation	USA HP	USA
Nizdorf		West Germany
Robotics Systems	ASEA	Sweden
Hitachi		Japan
Reis		West Germany

Machine tool computerized control Allen-Bradley USA Mitsubishi Japan Siemens West Germany SPC-PABX Ctr Alcatel France FATA Italy Erlcaaon Sweden 1TT Austria Austria Northern Tel Canada Philips Holland

National Institutions

The National Council for Informatics and Automation (CONIN) comprises sixteen ministers and eight representatives of the sector and advises the president of the republic on matters concerning informatics. The Special Secretariat of Informatics is the executive secretary for the council.

The Center for Informatics Technology is a government R&D center for informatics which provides $s_ci_{en}tifi_c$ and technological support to the community. It also acts as the technical advisory branch to the government in activities such as establishing standards, as well as monitoring the $fulfillm_{en}t$ of companies' commitments. The CTI has four institutes: microelectronics, software, digital instruments and industrial automation. The CTI welcomes cooperative projects, such as the one it is currently developing with several institutions concerning the development of tools for the automated production of software.

The National Plan of Informatics and Automation (PLANIN)

Every three years the executive branch of government submits to the National Congress a plan describing the objectives, $_st_{ra}t_egi_{es}$ and guidelines of actions to be undertaken in informatics. The first PLANIN was approved and became law in 1986. It contains conceptual guidelines, rather than quantitative goals, concerning the use and production of informatics goods and services, research and development activities and the education and training of human resources.

Every year the National Congress evaluates the results of PLANIN implementation.

Informatization in Brazil

The Brazilian people are well disposed toward informatics, as shown by the continued increase of the domestic market, as well as by the increase in the number of microcomputers in the country from 120,000 in 1983 to 670,000 in 1986, according to government figures. According to estimates, Brazil will have by 1989 around 35

microcomputers *per* 1,000 people, the same number as some Western European countries in 1985 (see table 2).

TABLE 2
Value of Some Markets for Mfaocomputers

Country	ValueinUS$Billions		Avenge Annual Growth Rate (Percent)
	1984	1987	
USA	13.1	20.0	15
Japan	1.6	3.0	22
Weal Germany	0.7	1.8	34
United Kingdom	0.5	1.3	34
France	0.5	1.2	33
Brazil	0.2	LO	74
Italy	0.3	0.7	27
China	0.1	0.7	81

SOURCE: U.S. Department *ofCommerce,* 1986.

In order to match the two apparently contradictory goals of increasing the productivity of the national economy through the use of informatics and using that very market to foster the emerging national industrial and technological capability, Brazil has adopted a method of planning which can be summarized as follows.

For a given issue (say, banking automation), a special temporary commission gathering specialists and final product users is formed to analyze and propose policies. SEI is usually in charge of the coordination of such works. The results are submitted to CONIN, which may require, before making a decision, that these suggestions are thoroughly and publicly analyzed by the community (academia, companies, goods and services users, governmental agencies, *etc.)*.

Results

Acting as manufacturers of computers and peripherals, in 1977 there were 3 national companies and 6 foreign companies. FOteign companies held 98 per cent of the country's market (roughly $_00 million at that time). Currently there are 364 national and 31 foreign companies manufacturing computers and peripherals, microelectronic goods, teleinformatics equipment, digital instruments and industrial automation equipment.

The Brazilian informatics policy emphasizes private initiative.

Among these 364 national companies, only 2 are government-owned, and their sales account for less than 5 percent of manufacturers' total revenues.

Most of the income of the foreign companies comes from the production and sale of large-size computers.

Revenues

The gross revenues, in the domestic market, of companies producing computers and peripherals were around $ 1.3 billion for national companies and $1.1 billion for foreign companies in 1986. The market share of national companies has been steadily climbing since 1979 and surpassed the share of foreign companies in 1984. Revenues of the

manufacturers of teleinformatics and industrial automation equipment in 1986 were $500 million and $200 million respectively.
National companies are just beginning to increase their exports. Foreign companies exported last year the equivalent of 20 to 30 percent of their income in the domestic market. The Brazilian informatics policy has not so far been export oriented.

Human Resources

In the manufacture of computers and peripherals, national companies employ many more university-level people for R&D than foreign companies, since foreign companies rely on R&D laboratories located in their home countries. The number of R&D workers employed by foreign companies for every $100 million in sales has remained static at less than 20 since 1981, whereas the number employed by national companies is on the rise and stood at over 200
per $100 million sales in 1986.

Internal Competition and Prices

National companies are in strong competition among themselves. As an example, there are more than 40 different national private companies producing more than 60 different types of mi
crocomputers.
The prices of microcomputers made in Brazil were at first higher than international prices, dropping to the same level within a
couple of years, repeating the pattern observed in other industries. On the other hand, the prices of Brazilian banking automation systems are below international prices. Recently, a national company won an international tender for an automated retail sales system for a hypermarket in Western Europe.

Microelectronics and Software

In 1981 Brazil had 16 foreign and 2 national microelectronics companies, all mainly assembling semiconductor electronic components using imported chips. The participation of national companies in the domestic market was less than one percent. Brazilian exports in microelectronics were less than $10 million, reflecting an industry oriented to the internal market, then evaluated at $160 million.
In 1986 there were 11 foreign companies, whose profile remained basically the same as that of 1981. On the other hand, there were 11 national companies, many of them having set up or setting up complete production cycles (R&D, design, front end, assembling and tests, etc.) for such components as digital and linear integrated circuits, power semiconductor devices, laser diodes, optical fibers and others. The participation of these companies in the market rose to 25 percent. More than 60 successful designs of custom and semicustom integrated circuits have been made so far by these national companies for domestic and foreign firms.
A Software Law sent to Congress last year was approved by the Lower House and is the process of being voted on by the Senate. This law provides copyright protection to software.

Research and Development

To survive in a highly competitive field, national companies are naturally obliged to come up with technological innovations. With this aim, they are upgrading their R&D capabilities and increasingly interacting with the Brazilian universities and R&D centers.
Among the relevant R&D projects that are being carried out in the country, many of them cooperative efforts by several national companies, universities and R&D centers, we may cite:
a) Artificial intelligence: The Brazilian-Argentinean joint
project, ETHOS.
b) Digital switching exchange, stored program controlled: a middle-to-large-size (16,000-subscriber) exchange is under final development. The small-size exchange is already being successfully produced.
c) Supercomputers.
d) New processor architecture.
e) Image processing.
f) Software: development of tools for the automated production of software.
g) Optical communications: Optical fibers and optical com
munications equipment are being manufactured with
technology developed in the country. Under development
are advanced semiconductor lasers and detectors.
h) Pr ocess automation of several kinds of industries. i) Microprocessors with a reduced set of instructions.
j) Integrated circuits: Tools for custom and semicustom
design.

international Cooperation

The Brazilian government looks forward to promoting cooperative!projects with other countries. Examples include the Brazilian-Argentinean joint project ETHOS concerning artificial intelligence and the Brazilian-Argentinean Informatics School, gathering more than 500 students and professionals from universities, R&D centers, industries and governmental agencies from many Latin American countries every year for an intensive two-week course.
There is also a West German-Brazilian scientific and technological cooperation program comprising more than a dozen projects being carried out cooperatively by institutions of both countries. A Portuguese-Brazilian cooperative program is also taking shape.

Conclusions

The informztization process of a developing country should be considered crucial. There is no doubt that informatics will pervade every aspect of the life of a country, providing enormous gains in productivity. But one should not underestimate the problems that the indiscriminate adoption of informatics may bring about, such as the extensive unemployment of nonqualified workers.
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Furthermore, informatics is based on advanced, sophisticated, ever-evolving technologies. Its users may not be fully aware of how dependent they become on the technological and industrial substratum which makes all those miracles possible.
We *believe* that the infnmatization process of Brazil, taking into account our peculiarities and potentialities, offers a unique opportunity to foster the technological and industrial capabilities of the nation, helping us to reach the twenty-first century as an industrialized country.
Underlying the Brazilian informatics policy is the concept that the Brazilian domestic market is a national *resource,* and that access to that market must be used as *leverage* toward technological and industrial development, in accordance with the *examples* presented by several advanced industrial nations.
Moreover, there is the understanding that the Brazilian informatics companies form an infant industry which is entitled to be *protected* until it is able to compete in the international arena. In thus respect, again, we follow the path of the industrialized nations.
Within this perspective, a significant number of national companies in all areas of informatics are appearing every year in Brazil, many of them spinoffs of Brazilian *universities* and R&D centers trying to *take* advantage of the possibilities created by technological transition.
Already in 1986, national companies accounted for more than 50 percent of the domestic market for informatics goods, which was estimated at more than $3 billion (hardware only).

Their investments in R&D were over 8 percent of net sales, thus promoting an increasing interaction between companies, *universities* and R&D centers,

This policy does not exclude foreign companies, capital and technologies; in fact, the major multinational company in the field had in 1986 its most profitable branch in Brazil, As mentioned before, international companies are *expected* to invest in those technology domains which are out of reach for national companies.

Progressively, the Brazilian informatics policy will allow the country to fully benefit from the blessings of informatics while avoiding its traps. It should make it possible for Brazil to have, as most of the advanced industrialized nations do, strong national companies competing, even for the domestic market, with 'foreign ones.

The Brazilian informatics policy constitutes a gateway to broaden the participation of the country in the international current of trade and ideas. Accordingly, the Brazilian informatics community, with its companies, universities, R&D centers and governmental agencies, welcomes opportunities to meet personalities and institutions of other countries in order to exchange ideas and to analyze the possibilities for business and technical cooperation projects.

CHAPTER 7

Thailand and the Informatics Revolution

Bhichit Rattakul

where is the wisdom we have lost in knowledge? Where is the knowledge we have lost in information?
Where is the information we have lost in data? Where is the data we have lost in bits?

Where are the strength, courage and vision needed to help lead IDCs to the informatics revolution?

Many of us are familiar with the two oft-quoted lines from
The Rock" by T.S. Elliot, written in 1939, before the advent of the informatics revolution. The second two lines were added by E.T. Uukakis of the Ford Motor Company. They typify a common complaint of the informatics age. The last two lines are my own rephrasing of the theme of the present roundtable.

Informatics is concerned with systems of information and their efficient handling with modern technology. The two key elements are, of course, information and technology, which will be the focus of this discussion.

From the perspective of developing counties, we can see that the informatics revolution is fed by a number of technological breakthroughs, particularly those in microprocessors and microelectronics, computer hardware and software, the new discipline of artificial intelligence, satellite communication, laser and fiber optics, and the digitalization of communication systems. The fruits of these technological breakthroughs make possible a marriage between the fantastic information processing capabilities of modern computers and modem telecommunication systems, capable of high-speed, large-volume data transmission.

Paralleling these breakthroughs in technology is an effort to compile and set up large banks of information in the form of specialized professional information systems. Many large networks of
special-purpose databases are coming into commercial service worldwide. Large-scale efforts in information gathering, transmission and utilization on a regional, national and global

scale are taking place. Some of the terminology used in Japanese literature, such as Teletype, gives one the impression that the information society is at hand or already here, if only in the more highly developed countries - Japan, the U.S. and Europe.

As the informatics revolution takes hold, many new concerns are voiced: the invasion of privacy, the danger of a controlled society, computer crimes, system failures, the disruption of vital computerized services, the emergence of new occupational skills and adjustments in the employment structure, changed economic competitiveness, rapid industrial restructuring, the malaise of social and psychological stress produced by working in the new technological environment. These concerns are addressed by designing various types of protection-for example, protection against computer crimes, system failures and abuses of information utilization.

On another front, as information-handling capacity expands rapidly, the desire grows to access even larger volumes of data. This leads to concern for information selection and a standardization of hardware, software and data organization which would allow linkages and information sharing on a large scale. Finally, there is also a concern for the humanization of the technological society, as evidenced in the Japanese slogan "flit-tech, high-touch."

Against this backdrop, the implications of the informatics revolution for developing countries can be examined. The contrast in the perspectives of developed and developing countries vividly points out the impact of the informatics revolution on these two different worlds.

Developing-country Perspectives

Looking back to our own surroundings in the developing countries, in contrast to the cool, aseptic world of high-tech, we see our own teeming masses in rustic rural settings and on congested urban streets, and the questions embed: Is the informatics revolution relevant to us? Should we be interested in it? What should be odor stand toward it?

First are the economic considerations. Whether we like it or not, the informatics revolution is here. It can be seen to be rapidly

changing the relative competitiveness of members of this increasingly interdependent world community, developed and developing alike. Not only is the informatics revolution propelled by technological advances; it, in turn, spawns great changes in productivity and future competitiveness. The new technologies made available by the informants revolution, such as office and factory automation, flexible manufacturing systems, intercontinental real-time computer interactive communications, ere., are posing serious challenges to what some developing countries used to rely on as their comparative advantages, particularly low-cost labor. The relocation of certain manufacturing units from sites in developing countries back to developed countries is already taking place. This trend poses an increasingly grave challenge to those developing countries struggling to industrialize.

On the other hand, the new technologies also open up new possibilities for developing countries to enter into specific categories of manufacturing without the need to make large-scale investments in heavy equipment and other physical infrastructure, as was previously the case. Miniaturization, and the consequent reduction of material and energy consumption, may seriously change existing comparative advantages in material and energy resources. Certain new manufacturing industries (such as production or packaging of microprocessor chips) yield

products of such small bulk and high value, and so many forward industrial linkages, that they are powerfully attractive investments. The economics of the changed competitiveness effected by new technologies calls for a reconsideration of approaches and strategies for industrialization in developing -countries.

From a long-term perspective, technology development is the key to economic viability and competitiveness. The informatics revolution, with its two crucial components of information technology and communication technology, covers a substantial portion of the emerging technologies which will fuel industrial development in the coming decades. To acquire a technological base for the future, it will be necessary for developing countries to join, or at least follow, the informatics revolution.

The power of the informatics revolution to influence the future intellectual development of mankind is vividly revealed when one observes school pupils in some developing country play on and poke at their locally made Pineapple PCs (or any other local microcosm-

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are being used in tertiary education but not much in secondary education. There is a keen but modest effort to develop compute raided instruction (CAI) software.

On the manufacturing side, Thailand is host to a number of foreign-owned production facilities. Packaging and assembly of integrated circuits (microprocessor chips), computer

keyboards and other specialized items are providing large export earnings, although there is a concomitant large import of intermediate products. In 1987, there was a large increase in foreign investment in manufacturing and assembly plants for electronic products, primarily from Japan and owing principally to the rising value of the yen compared to the local currency.

The Thai government has a basic policy of emphasizing the application of science and technology for economic development and strengthening the science and technology systems to provide an infrastructure for future development. The current Five-year Economic and Social Development Plan contains a prominent chapter on science and technology development. Among the key priorities is the development of technological capability in the areas of electronics and information technology. Just before the launching of the Sixth Five-year Plan in 1986, the government made a serious commitment to developing science and technology by undertaking a soft loan from the U.S. government in the amount of $ 49 million for what has become known as the STDB Project. The main emphasis of the project is the strengthening of research and development capability in biotechnology, material technology and applied electronics, including information technology. Another component of the STDB Project is the establishment of the Technological Information Access Center (TIAC), which will serve as the channel for receiving technological information from the U.S./ASEAN Technology Information Exchange Center in New York.

Another governmental action taken is the establishment this year of the National Electronics and Computer Technology Center (NECTEC) in the Ministry of Science, Technology and Energy. NECTEC is currently formulating priority R&D projects for the development of technology for the electronics and information industries and the establishment of a national computer software development center. The National Research Council of Thailand has also been supporting some small-scale research projects in computer software development.

On a broader economic front, the Board of Investment (BO1), which is chaired by the Prime Minister, is now for the first time linking foreign investment to technology transfer. Some of the first projects are in the area of manufacturing and assembly of electronic and communication devices.

More systematically, the Thailand Development Research Institute (TDRI), the leading policy research think-tank in the country, recently started a research project to work out the priorities, strategies and policy measures for developing technological capability for the electronics and information industries, among other sub sectors.

Planning the establishment of large-scale information systems is also under way. These include the National Information System in the Office of the Prime Minister and other large information systems centered around the National Library and the Ministry of Education. International information systems networking is also being initiated - for example, the link to TECHNONET in the Ministry of Industry and to ASTINFO in the National Research Council.

While these varied activities, initiatives and plans are useful and even important, the crucial action which has yet to be taken is to spell out the basic direction, policy guidelines and structure of a more orderly and systematic development of the technological and information capability of the country. The Ministry of Science, Technology and Energy is supporting and providing the necessary impetus for this development. Consideration is being given to the feasibility of adopting some basic information structure such as the ISDN (integrated services digital network) and to the development of informatics capability for educational systems. natural resources planning and management, health care delivery, agriculture and industry,

trade and service industries, etc.

Priorities for International Cooperation

Although developing countries appreciate the vital importance of the informatics revolution for our future, we are also painfully aware of the limitations in our ability to partake of this latest of mankind's revolutions. Many thinkers in the developing world are concerned that, if sufficient care and courage are not called upon, the informatics revolution, instead of bringing the human family closer and making it more homogeneous and harmonious, could further polarize and widen the gap between the North and the South.

To help narrow the gap and to bring humankind together to enjoy the fruits of the informatics revolution, international cooperation and assistance are needed. Priority areas for international cooperation in informatics include the following:

a) Cooperation in access to international information systems and databases.
b) Cooperation in the planning of national information systems.
c) Cooperation in strengthening capabilities for the utilization of domestic information.
d) Cooperation in planning for educational development using information technology.
e) Cooperation in technology development and technology transfer.

As an example, let us consider only the first point. There are many weaknesses and constraints in the ability of developing countries to access and make use of international information. Some examples are

a) Lack of basic know-how and experience.
b) Inability to adapt available information for new purposes. c) Lack of foreign exchange and sufficient funds to meet the high costs of access.
d) Unwillingness on the part of some information sources to share information.

Up to now, .developing countries have served primarily as markets for the technological products generated by the informatics revolution in developed countries. To help the developing countries benefit from this great movement and eventually be better prepared to participate in and contribute to it, a first effective action would be to help developing countries gain access to the great pools of information being organized and established in the international community.

To make cooperation in informatics feasible and practical, much mutual exploration on specific areas, issues and concerns is needed. Specific tasks should be identified and action plans formulated. Only then can the relevant roles and activities for the various governments, international organizations, development agencies, NGOs and private enterprises be clearly formulated.

To help bridge the gap between the developing and the devil-opted countries through international cooperation in informatics, strength, courage and vision are needed from both the more developed and the less developed members of the international community.

CHAPTER 8
The Informatics Revolution: The Indonesian Experience
S. Abdulrachman

History has proved that the speed of communication or information transmission

determines the speed of the development of mankind. Since electronic means of communication and information processing were introduced, the speed of development of mankind has accelerated greatly.
Through the integration of data processing and telecommunication technologies, almost all tasks can be performed faster and more efficiently than ever before. Thus, in countries where the telecommunication infrastructure is underdeveloped, the efficiency of economic and social life suffers. Informatics - the use of modern technologies to communicate (interactively) between individuals or groups via the exchange, processing and dissemination of novice information - consequently cannot develop optimally within countries or between countries where the telecommunication infrastructure is not sufficiently advanced.
How do such countries cope with these problems in their efforts to accelerate the advance of informatics for the benefit of the nation, and what are the results achieved so far?

Telecommunications Development

In Indonesia, public telecommunications are provided through two state-owned companies. PERUMTEL operates the domestic services, while international telecommunications are carried out by INDOSAT. Services provided to the public include telephone (fixed and mobile service); telex; telegraph and gentex;telefax and bureaufax;and packet mode data service.
The telephone service has the highest penetration throughout the country and provides local service, subscriber long-distance dialing and international calls (IDD). At the present level of supply.
nearly one million lines are still insufficient to meet the demand for telephone service, and there are lengthy waiting lists.
Several government agencies, such as the meteorological bureau, customs, police and public works, operate their own networks for internal telecommunications. Other organizations use leased circuits from PERUMTEL and INDOSAT.
The development of telecommunications in Indonesia has been relatively swift, notwithstanding the higher priority allocated to the development of agriculture, mining, industry and basic infrastructure, such as roads and electricity. However, the penetration or density of telephone service is one of the lowest in the Asian region, at about 0.5 telephones for every 100 people.
As a basic requirement for an archipelago made up of some 13,667 islands strung along the equator and spanning more than 5,000 kilometers, long-distance communications, whether through microwave, domestic satellites or cable, occupy our no ending attention. Indonesia has established a good quality network interconnecting all major cities, with a phased penetration into smaller cities. In fact, the domestic satellite or PALAPA system is distance insensitive, so that even the remotest island, if need be, can be connected in a very short time.
The terrestrial microwave system stretches along the major islands of Indonesia. As for spur routes or other routes required to reach the more remote areas, spur route systems have been developed by using overhead coaxial cables or microwave. Besides terrestrial systems, Indonesia has also had its own domestic satellite system since 1976. At present, Indonesia's satellites are equipped with twenty-four 8-generation transponders. Information and data flows throughout the nation were very much improved by the domestic satellite system.
The transmission means used for international links are satellite links (INTELSAT,

INMARSAT) and submarine cables.

Another basic requirement for communications is reliable local switching and distribution networks. Even with the low density of local telephone lines, priority has been given to the productive sectors in fulfilling their urgent need for basic communication services, so far with reasonable success. This does not mean that substantial additions and improvements are not required. It only shows that through unrelenting efforts toward expansion coupled with using the available facilities in the most efficient way possible, a
basis can be laid for the telecommunication infrastructure needed for informatics.

A number of manual exchanges are to be replaced by automatic (digital) exchanges to allow subscribers to direct-dial to all districts. The most difficult problem still to be tackled is communications to the sub district areas. The total number of these sub districts are around 3,500, only 50 percent of which are currently covered by telecommunication services.

Over the past few years, the expansion of automatic telephone exchanges has been accomplished essentially through the construction of digital telephone exchanges, while new transmission projects, including transmission through the PALAPA satellites, use digital equipment. Digitalization of exchanges was begun in October 1984, followed by the installation of numerous digital switches produced domestically in Indonesia. Digitalization represents a major turning point in the economics of telecommunication: it integrates information regardless of whether it originated as voice, computer data or image, and it allows the same facilities and equipment to be used for a range of services. These services have a high degree of utility, as they permit the integration of functions, as well as dramatically better economy of use and productivity.

Digitalization in Indonesia is only a first step in the evolution of the telecommunication network toward a universal and integrated network, or ISDN (Integrated Service Digital Network). Soon, pilot projects for the national ISDN solution will be executed in order to obtain a better understanding of its characteristics, to gauge the response of the general public and to prepare for implementation on a larger scale.

In 1984, the first node of the national Packet-Switched Public Data Network (PSPDN) was put into service. Today, this service is available in four cities. This packet switch is also the national gateway, thus providing packet-switched data communication services to and from Singapore, the USA and Europe. This PSPDN makes possible database access, computer time-sharing, file transfer, and computer-to-computer communications. Additional solutions using the PALAPA domestic satellite system will also enhance communications in Indonesia. Indonesia is carrying out experiments to integrate the PSPDN with PACKSATNET, an experimental Satellite Data Packet Network.

Application of Informatics for Increased Productivity

Even in the short time that public data communication services have been available in Indonesia, valuable experience has been gained. Several value-added networks utilizing the Indonesian PSPDN are being set up for research and development, such as the UNINET for data communications between major universities in Indonesia and the AUSIANET for data communication between research centers in Australia and Asia. An experimental teleconferencing system utilizing the Indonesian PSPDN to connect participants in Indonesia with the Gulp University in Canada is currently being tried out. UNINET will connect forty-five Indonesian universities in three phases. As an interuniversity computer network with a national scope, UNINET will fully utilize the public telecommunication network. At present, universities

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Cooperation in the field of telecommunication training, sponsored by the International Telecommunications Union and the U.N. Development Programmed with valuable hardware assistance from Japan, has the objective of exchanging information on course materi-als for telecommunication training between cooperating training schools in the Asian region through computer communications. Other major networks are operating or are under preparation for the oil industry, banking and finance, transportation, tourism, meteor-ology,etc.

These are but a few of the informatics activities under way in Indonesia. The general attempt is to try to find the most suitable solutions for one's own country. These may not be the best for another country due to differences in socioeconomic, cultural and educational factors, as well as the state of available facilities within each country.

The convergence of computers and communications is spurring the development of a new industry based on information technology which is rapidly penetrating our society and affecting all aspects of our lifestyle. Personal computers and work stations have become available at consumer market prices and quantities, resulting in an explosion in the use of computers at home, often for business-related purposes. In this case, information technology improves personal and organizational productivity.

While tale companies, the c dominated by pry computer-related c

Types of Products

Suppliers Hardware

Mainframe and large

Mhda

Micros, super micros Data communication Computer services bureaus Computer cousulisncy/ Software

0.5.

DBMS

P_{rogram} and system

Compilers

Large system and Midrange application $ Microcomputer-band a System and software h Software houses

CAD/CAM system

Robots

SOURCE: Indonesian Natio

Problems and Constr

Indonesia is efforts to catch up problems and cons tries may have similar answer include:

a) Are the as

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b) Are the in

I08/Developing-country Perspectives

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While telecommunications in Indonesia are handled by state companies, the computer and informatics industry is currently dominated by private companies. Table 1 shows some facts about
computer-related companies in Indonesia.

TABLE I

Computer Companies in Indonesia, 1985	
Types of products	Number of ComRtdes
Suppliers	141 hardware
Mainframe and lag, computer system,	12
Minis	21

Micros, super micros 83 Data communication 24 Computer services bureaus 19 Compute, consultancy/microfiche/microfilming services 33 Software
O.S. 38 DBMS 35 Program and system genentors 23 Compilers 32 Urge system and mainframe application software 10 Mid-range apportion software 26 Microcomputer-based application packages 34 System and software houses 15 Software houses 7
CAD/CAM system 10
Robots
SOURCE: Indonesian National Computer Conference (September 1987).

Problems and Constraints

Indonesia is one developing country which is malting earnest efforts to catch up with the developed world. In these efforts, many problems and constraints are encountered. Other developing count-tries may have similar problems. Major questions such countries must answer include:

a) Are the available facilities and capabilities (computers and communications) already being utilized to their maximum capacity?

b) Are the informatics programs in harmony with efforts in
other important fields of national development?

c) How aware are the managers of business and government organizations of the possibilities of improving their efficiency through informatics?

d) How much effort should be given to establishing an
intergovernmental office information system?

e) How can the confidentiality and security of data and
information be safeguarded?

f) How can the country's indigenous manpower be prepared to support the communications and informatics system in quality and quantity?

g) What steps should be taken to ensure the transfer of technology and know-how in the field of informatics and telecommunications?

The first step for developing countries to take to answer these questions is to formulate concrete policies and strategic plans for the development of both the telecommunication sector infrastructure and the informatics sector in an integrated manner.

To achieve this integration, a continuous dialogue needs to be established between the two sectors. The government, individuals and private-sector organizations should all participate in seeking an optimal formulation beneficial to all concerned.

For the telecommunication sector, several solutions have been formulated in Indonesia, such as the strategic development plan for the integrated digital network (IDN). Ongoing studies are addressing the need for ISDN development and for a master plan for nationwide data and text services.

In the field of training and transfer of technology, regional as well as international cooperation should be continued and intensified under various auspices.

In the legal field, a new telecommunication law is being pre-pared which will provide a basis for regulating value-added services, policies on terminals, etc.

The swift development of the new technology creates the possibility of constructing very advanced information networks offering sophisticated services. This approach would require huge amounts of capital investment which only some of the more highly developed countries could afford. For developing countries, a tech-neology-driven approach to development is a luxury they cannot afford, since many of these technologies still have to he imported
from the developed countries. The situation would be different if the technology were already mastered by the developing country.

The other approach to development is demand-driven, where the demand of the user is the primary factor motivating develop-mint. This approach depends heavily on the desire of the user, which is usually shortsighted and low-price-oriented, neglecting the strategic aspects and the overall development potential of the industry.

In Indonesia today, the main agent of development is the government, through its policies and projects. In its approach to development, it is hoped that the government will consider all factors and balance the interests of all sides so as to set correct priorities and policies for the

implementation of development according to the requirements of the country. Present development efforts are guided by a concept of strengthening national unity and national socio-economic and cultural resilience.

Conclusions

An exciting future is emerging which promises great benefits. Technology will play a vital role in the development of informatics due to the involvement of the telecommunication sector.
Indonesia's existing telecommunication facilities and services can be used as a starting point for the development of informatics in Indonesia, although expansion and improvements are necessary. Developing countries should give the maximum attention to develop-ping their telecommunication infrastructural capabilities in order to serve their informatics needs.
However, the deciding factor in reaping the optimal benefits will always be the brain power - the human factor, mobilized and equipped to respond to these challenges. A smooth transfer of know-how and technology requires early investments in developing the skills and knowledge of the indigenous manpower.
Cooperation between nations, both North-South and South-South, can play an important part in extending the benefits of informatics.
Developing countries should formulate concrete national policies and strategic development plans in telecommunications and informatics and then execute them in an orderly fashion.

CHAPTER 9

Colombia and the Informatics Revolution

Fernando Jordan

The innovations now being introduced in the wide field of informatics, and especially their repercussions in telecommunications, automation and robotics, have effected dramatic quantitative and qualitative transformations in all levels of human relationships.
Colombia is very much involved in informatics as both a user and a manufacturer. We are beginning to make use of CAD/CAM technologies. The country is also quickly developing its telecommunications. Given all these recent developments, it is no coincidence that the two most recent governments have tried to develop a co-hesive and progressive informatics policy.
Colombia is well aware of the fact that informatics is a delicate tool. It may serve to foster economic development and social justice or, if inappropriately handled, may lead to very unequal social development. Thus Colombia has tried to promote the extended use of informatics throughout society so that everyone can enjoy the benefits of this enormous technological revolution.
Colombia is also aware of the fact that informatics overlaps with geopolitics. Disputes between Japan and the U.S. over trade policies on computer parts (microchips), and between the U.S. and Brazil over market reserve policies, are familiar to us. We know that we must stimulate the use of informatics beyond circumstantial trade conflicts.

The Colombian Informatics Policy

The Colombian informatics policy (the Indicative Plan) is based on ten basic premises:

a) Informatics and high technologies are born with the demand of the existing world economy to transform its rigid productive and organizational structures into flexible ones. By way of example, informatics makes flexible the
massive and automatic transfer of information and the process of decision making.
b) The informatics phenomenon is associated with the profound changes that are taking place in the productive structures of all countries.
c) The informatics industry - the manufacture of both hardware and software - should be considered a basic industry, since informatics will fundamentally affect the cost structure of the entire Colombian economy - its competitiveness and level of development, its configuration, the balance between its branches, and the selection of productive processes and production factors.
d) All informatics policies should cover both sides of the economic equation (supply and demand). Since the development and generalized use of informatics technology is necessary for strengthening the national economy, it is essential to define ways to (i) gauge and expand the demand (price, training, user protection policies, etc.) and (ii) increase the availability of the supply through production policies, import policies, foreign investment, adaptation and selection of products, attention to cost structure, etc.
e) In countries like Colombia, informatics must be at the service of the economic and social development of the country. This must take priority over the merely economic objective of developing a domestic informatics industry per se.
f) Developing countries need to incorporate these types of technologies in a rational and planned manner resulting from an informed evaluation of the costs and benefits in the public as well as the private sector. Planning should take advantage of international experience in order to minimize mistakes, guarantee the necessary infrastructure, and guide investment and action by the government.
g) The potential of each country to benefit from informatics technology will depend mainly on its capacity to select suitable applications.
h) For developing countries, the training and education of users is essential for equipping them to contribute to the economic and social development of the country.
i) The development of informatics in our countries will be possible only insofar as our frontiers are open, and insofar as producers are willing to allow us access to their prod-acts.
j) Informatics should be specifically used to strengthen democracy in each and every country of the world. Its greater or lesser presence in a country will be one factor influencing the balance between peace or war.

Questions for Policy Makers

The majority of our countries do not have clear or consistent
policies to deal with this new sector, or institutions to cope with it. Questions that arise when attempting to define the fundamental
aspects related to informatics promotion and development include: a) Should a developing country produce or assemble? b) Is software a good or a service?
c) What customs regulations, tariffs, import strictures, commercialization policies and royalty arrangements should be applied?
d) What promotional and educational policies should be developed?
We should not forget that resource constraints being ever-present, we have to balance informatics (which at first glance may seem to be a luxury expense) against hunger, lack of

housing, un-employment and other pressing priorities. As computer systems methodology teaches, we have to plan the allocation of resources, especially when there are limitations on them.

What is an Indicative Plan?

An Indicative Plan drafted by a government commission to elucidate official policies is a planning instrument which establishes clear and consistent criteria so that the government can take action at the macro level on a sure and concrete course. Such a plan should seek to harmonize public- and private-sector interests.
The fundamental objective of an Indicative Plan is to identify the main problems and opportunities offered by the development of a productive sector in order to formulate a series of recommendations that will contribute to its growth.
Specific Objectives of the Plan

An Indicative Plan should be geared toward;
a) Training the potential users of informatics technology, both public and private, to evaluate the individual and social costs and benefits of adopting the new technologies.
b) Maintaining a supply of informatics goods and services according to the needs and demands of the country.
c) Expanding internal demand.
d) Proposing an institutional order capable of executing, monitoring, evaluating and revising the informatics plan.
e) Suggesting techniques and assigning responsibility for collecting data and spreading awareness in order to forum-late industrial, employment, education and foreign trade policies which make use of informatics.

Priorities of the Plan

The plan should give first priority to developing user potential
in both the public and private sectors. Instruments directed toward
the formation of human resources include:
a) Clear and strong relationships among universities, enter-
prizes, government and unions for the development of
informatics applications.
b) Participation in foreign training programs. c) Technology transfer programs.
The second priority should be to take the necessary measures to
guarantee a continuous flow of the supply, as interruptions in
production or distribution could adversely affect the national
economy. Such measures include:
a) Collecting and disseminating data on national and internal-
tonal demand.
b) Breaking down public demand into a list of priority
investments and programs regulating official purchases.
c) Forming an association of producers and distributors to
obtain savings, to strengthen the negotiating capacity, and

to ensure optimum utilization of the public sector's
hardware and software.
d) Associating national producers with foreign producers. e) Producing software in association with foreigners.
f) Using tax-free zones more intensively.
g) Granting credit and tax incentives to stimulate internal production.
The third priority should be to avoid erecting protectionist barriers. A balance must be struck between acquiring and utilizing the most advanced technologies and upgrading the domestic capacity to participate in technological advance and international competi-tion. Official intervention to stimulate domestic production should not lead to the erection of barriers that willl protect inefficient industries or foster monopolies. Some measures that could guarantee that high-quality informatics resources produced abroad will remain available at competitive prices include:
a) Reduced custom tariffs.
b) A free import regime.
c) Establishing intellectual property rights and enforcing respect for such rights.
A fourth priority is to stimulate the domestic production of informatics products. National producers and distributors can be encouraged in ways complementary to policy orientation and re-pensive to market demand.

A Need for Greater Study

Colombia's limited experience in considering the informatics potential of the country indicates that a more comprehensive study must be made to assess the possibilities of informatics in depth, as well as to evaluate the most appropriate tools for implementing governmental goals in this new field.
Such a study should begin with a global, interdisciplinary diagnosis of the economic, social and political dimensions affected by informatics innovations and move on to the evaluation of specific policies to promote the rational use of informatics. Fields that demand official intervention should be explicitly identified.
Such a study would fill a gap in the official and public know-edge of the important social and technological forces that are affecting every society today. The time is ripe, because the informatics era is in its childhood, and there is still the possibility of reorienting the process of change, predicting the consequences, and identifying the major risks as well as the rewards of informatics development.

CHAPTER 10

Africa and the Inforrnatics Revolution

Ralph A. Akinfeleye

As we move nearer to the end of the 1980x, Africa continues to ponder what possible policy options to adopt in the acquisition and use of informatics in the 1990s. Certainly, Africa does not want to be left far behind the rest of the world in the informatics revolution. African countries do not have sufficient funds to manufacture their own software and hardware, yet they want to-and must-use informatics for development. Clear-cut and rational policies are an imperative for

Africa's vertical and horizontal economic and political development in the 1990s

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At a recent pan-African conference held in London, the pries-dent of the World Conference of Mayors, Mayor John Ford of Tuskegee, Alabama, USA, called on Africa to ponder over the "four T's" of industrial and technological development: trust, trade, tour-ism and technology,' with the greatest emphasis on the latter. He said that the future African technology will include the transfer and training of both appropriate technologies and technocrats. By allusion, this T for technology will include an African informatics revolution-the acquisition, procurement, manufacturing and use (or misuse) of informatics for development.

One of the resolutions of this conference asserted that "the world is so dependent on Africa, and as such, Africa should not continue to wallow in abject poverty and technological and eco-gnomic degradation." This position derives much from the fact that Africa alone produces 65 per cent of the world's gold, 74 percent of the world's cobalt, 75 percent of the world's diamonds, 70 percent of the world's chocolate/cocoa, 30 percent of the world's peanuts, 66 percent of the world's sisal, 30 percent of the world's manganese and about 75 percent of the world's other valuable raw materials for industrial and technological use.'

In spite of all its potential, Africa today remains the least developed continent in the world, particularly in the area of inform-

mastics. Africa is faced with the dilemma of whether and how to adopt informatics technology. All African nations want informatics for development. Some want it with no conditions attached, while other want it in exchange for their valuable natural resources.

The current trend in most African nations today is to import informatics software and hardware, since hardly any African country is as yet able to manufacture its own products. The well-trodden path of dependency, however, may not be to Africa's advantage. Informatics experts from the developed countries have continue to recommend various means and modes of adoption and acquisition of informatics for Africa. But because of the poor economic state of Africa, and because of the very expensive nature informatics prod-cuts, experts have been reluctant to transfer informatics manufacturing technology to Africa, although this is what Africa needs most urgently. Some African nations which have chosen the assembly option-Nigeria, Ivory Coast, Senegal-now find it inadequate for their developmental needs.

Certainly, the political and economic situation of any society will influence the type of informatics that operates in that society. It logically follows that a nation that has a sound economic foundation will have a well-developed informatics network, while a nation that has a poor or unstable economic foundation will have an under-developed or no informatics network.

Most of the developing countries of Africa fall within the latter category. What is ironic is that while the developing countries now need an effective informatics network much more than the developed world, informatics in developed countries, besides being put to legitimate use, has opened yet another avenue for recreation and conspicuous consumption.

Current Trends and Policy Options

As stated earlier, most African nations want and need an informatics network for development. Their major handicap is the lack of money and the technological know-how to manufacture their own software and hardware. Since they are not at the moment able to keep pace with the rapid changes and challenges of the informatics revolution, their preoccupations are the procurement via importation of finished products or the assembly of imported components. Neither of these

options is appropriate for the rapidly growing
economies of developing Africa.

While African nations as yet have no clear-cut and well-articu-lated national policies on informatics, the more developed countries formulated theirs decades ago. As far back as 1960, the industrialized nations developed a combination of organizational and regional policies on informatics. They even went so far as to formulate national and regional public regulations to strengthen the rights of privacy and confidentiality within large-scale personal data systems. In 1974, the French Minister of State for the Interior remarked, "For several years in France, legislative and regulatory programs have been proposed but rarely adopted. We have now arrived at the state where we have to choose and decide... Clear roles should determine the conditions of creation, use and control of files per-tainting to individuals,°

By the mid-1970s more and more countries of Europe and North America had begun to install national data protection laws. Three basic data laws have emerged: (i) the no legislative declaration of good practice (the British model); (ii) fair information practice standards and judicial enforcement (the USA model); and (iii) data protection registries and commissioners (the continental European model). From time to time, the provisions of these informatics laws have been amended to meet new challenges of the informatics revolution.

Most developing countries have no such informatics laws. The argument for the no promulgation of such laws is the fear among some developing countries for the fate of their country's individual privacy and national security. Such countries believe that national security can be rendered meaningless by uncontrolled transporter data flows, which are made possible by computer networks.

The Intergovernmental Bureau for Informatics (IBI) has already organized several conferences on the issue of transformer data flows, but there is as yet no agreement on which model to follow. However, the basic foundation of any law will be the following principles:

a) Information should be used for specific purposes, and not
without appropriate authorization for other purposes.

b) Access to information should be confined to those author-
sized to have it for the purpose for which it was supplied.

c) Information collected and held should be the minimum
necessary for the achievement of the specified purpose.

d) There should be arrangements whereby the subject can be
told about information concerning him.

e) Care should be taken in coding value judgments.

f) In the design of information systems, periods should be specified beyond which information should not be re-tainted.

This serves to show how far ahead the industrialized nations have gone and how far behind the developing countries are in the formulation of national informatics policies.

Certain important questions need to be answered before developing countries can formulate their own recommendations. These questions are based on three foundations: the historical foundation (how it was), the sociological foundation (how it is), and the philosophical foundation (how it ought to be). Other pertinent questions include: How far have we gone in the informatics revolution? What is our present position? What are our options? What is the best choice for us?

The utilization of informatics in Africa at the moment is mostly for payroll, accounting, and the assemblage, storage and retrieval of statistical data for development. Africa is not yet party to the other, more sophisticated uses (and misuses) of informatics now being practiced by the

industrialized world.
In 1980, at an African Intergovernmental Bureau on Informatics conference held in Lagos, Nigeria,' An African Plan of Action was formulated. As a follow-up to the Lagos Plan of Action, another AIBI conference was held in Ivory Coast' with the objective of mapping out specific strategies and tactics for implementation of the Plan. At this conference, it was noted that Africa's share of the world's relative expenditures on informatics was merely 0.3 percent, while on a comparative basis, that of the more developed countries stood at 95 percent. It follows to icily that while the more developed countries of the world account for 95 percent of informatics spending, only 5 percent is spent by the whole of the developing world. Out of this 5 percent, the Middle East, Southeast Asia and Latin American countries spend the larger portion, leaving African nations with less than one-half of one percent. Yet African countries ¯continue to be interested in the adoption and use of informatics for development, despite this evidence of an ever-widening informatics gap between the North and the South.
Concerning Africa's desire to reduce this gap, and in her efforts to adopt appropriate informatics tools for rural and urban develop-
great risk. Adoption of this option could impede the economic growth of a nation, leading to the mismanagement of both human and material resources.
Despite all its demerits, government control of informatics development may be necessary for developing countries, particularly during the early stages of acquisition. Right now, since the developing countries have no other adequate policy option, this is the best course available.
No page

Development through Joint Ventures

In this situation, both government and private individuals, companies, corporations, multinationals, etc., will jointly formulate and observe guideline, rules and regulations with respect to informatics. Planning, execution and monitoring are jointly carried out by both government and private agencies.
The major demerit here is the constant conflict between public send private parties. There will be great pressure on the government at all times, to which it may be forced to yield, covertly or overtly.

Development by Multinationals

This option is more or less a total sellout of one's country to powerful foreign corporations. A situation in which all the i_nf_{or}-matics'systems are owned and controlled by foreigners (whether multinational corporations or a particular donor country) is a danger-oust risk to national sovereignty. Multinational corporations cannot be expected to respect either national or individual privacy and security. No developing country should adopt this policy option.

Deferral of Informatics Development

After examining all the advantages and disadvantages of informatics acquisition and development, particularly the expense of acquisition and maintenance, a country may decide not to acquire informatics for any purpose.
The demerits of this option far outweigh its merits. Such a policy will lead to a total lack of statistical information for decision-making and hinder the socioeconomic growth and

development of
The nation . it will have the effect of a total information blackout . No developing country can afford to cut itself off from the rest of the world by ignoring informatics.

Informatics Assistance for Developing Countries

It is imperative to analyze what kinds of assistance the develop-ping countries need from the more developed countries in the area of informatics.
Since informatics is a revolution, it brings about rapid, accelerated developmental changes in the society in which it operates. Informatics products are very expensive to develop, acquire, maintaint and use. Most developing countries cannot afford to manufacture their own informatics software and hardware. They depend on the developed countries to supply their informatics needs.
All public and private sectors of developing countries need appropriate informatics systems for effective assemblage, storage and retrieval of relevant data to facilitate their decision-making processes. Specific developed-country assistance will be needed in several
critical areas.

Informatics Education

There is a need to train and retrain developing-country citizens in informatics. Trained manpower is essential for the day-to-day operation and maintenance of informatics systems. Both domestic and foreign training should be provided.

Rebates

Developed nations should offer price concessions to developing countries wishing to purchase informatics software and hardware.

Intercontinental Informatics Networks

Developed countries should assist the less developed countries in their attempts to set up their own intercontinental informatics networks. This is especially important. By eliminating the situation whereby Lagos (for example) has to go through Paris or London to get pertinent developmental information from neighboring Loma or Raninl not only is efficiency increased, but dependence is lessened.
Ghana (for example) should be able to get critical developmental data on rice, yam, cassava, etc., from the International Institute of Tropical Agriculture (IITA) in Iberian at the touch of a button. Agro-based communication systems are vital for developing African economies, which do not need sophisticated machines such as the OMNI-Reader, but only functional machines that can do the job.
Developing countries must also be guaranteed unconditional and dependable access to inexpensive spare parts so that they can maintain their systems.
Reliable Power Supplies
The provision of dependable, regular, uninterrupted electrical power is a prerequisite to the effective operation of an informatics system. As of now, most developing countries suffer an

irregular and
undependable electricity supply. Developed countries could assist developing countries in exploring new energy sources.

Domestic Manufacture

The ultimate goal of the developing countries in their desire to join the informatics revolution is to be able to manufacture their own informatics software and hardware. In this area, unstinting assistance is needed from the industrialized countries. Such unconditional assistance is in the interest of developed countries, because informatics independence will significantly enhance the stability and economic viability of the developing countries.

Conclusion

To narrow the widening gap between the North and South requires reciprocal socioeconomic and technological cordiality. Let the South supply the needed raw materials while the North supplies the $tech_{no}l_{og}i_{ca}l$ know-how.

Note.

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CHAPTER II
Informatizatfon and Development: A Chinese View

Qin Linzheng

It is of great importance to all countries of the world to study the new problems raised by the informatics revolution and to explore the prospects for socioeconomic development which this revolution unfolds. Such studies and exploration have gone beyond the limits of academic circles and become increasingly linked with the work of government departments responsible for planning, programming, management, development strategies and policy making.

It is by no means easy to list all the problems posed by the informatics revolution, but most of them fall into five categories:

a) Evaluation and assessment of the revolutionary progress of informatics and its impact on economies and societies.

b) Identification of challenges, opportunities and constraints encountered by developed and developing countries in the wake of the informatics revolution.

c) Discussion of development strategies and policy options in normalization for developed and developing countries.

d) Possibilities for North-South cooperation in the inform-mitigation process.

e) Speculation on the future of infonnatized societies and an infornatized globe.

These five groups can be further reduced to two basic groups: informatization, and the study of development strategies for infor-matization.

By informatization, we mean a process of development aiming at high-level exploitation and use of sophisticated information resources not only for science and technology applications, but for every branch of the economy and society. By a study of develop-mend strategies for informatization, we mean the newly emerging domain of strategy research with informatization processes, require-ments, trends, goals, principles and policies as its object.

Focusing on informatization, this paper will discuss patterns of industrialization in combination with informatization; development strategies for informatization being pursued by the developing countries; current issues and future trends which bear on the North-South relationship; and policy options which can strengthen research capabilities, support effective informatics development strategies, and speed up the process of informatization in developing

countries.

Industrialization and Informatization

The modernization of a country implies the modernization of both its material and spiritual civilizations. The total development of a country includes the development not only of its productive forces, but also of its productive relations. It is not only economic, but also social; not only quantitative, but also qualitative. No country is truly modernized until all its productive and social capacities have attained the highest existing world standard.

The developing countries have taken as their model far modern-ization the most highly developed productive societies of the modern world. Obviously, there is a great gap between the productive and social capabilities of the developing countries and those of their most advanced counterparts. Only by closing, and not simply narrowing, this gap can their modernization be realized. This will be a long-Ten., arduous task. Some Chinese scientists and technical experts estimate that the overall level of science and technology in China at the end of this century will be equal to the most advanced level of the world of today - the 1980s. That is, the time gap between China and the developed countries is on the order of ten to twenty years. Obviously, this means that the overall level of science and technology in China in the year 2000 will be ten to twenty years behind the most modernized level of that time.

As for the economy, China's goal in terms of per capita GNP is $800-1000 by the end of this century, and its overall goal is to reach the standard of the middle-income developed countries by the middle of the next century. Even if the above goals are realized, the gap in per capita GNP or per capita income between China and the developed world will still not be bridged even after half a century. Even more time will be required to change China's economy from a backward into an advanced one.

Thus the criteria for modernization are not fixed, but ever-
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changing. The standards of the future will inevitably be higher than those of the present.

Today's concept of modernization takes industrialization as its standard. Tomorrow's standard will be informatization. Thus while many of the developing countries are still pursuing industrialization as the main objective of their struggle, some newly industrialized countries (NICs) are becoming competitive in the field of informati-zation. Developed countries, meanwhile, have evolved from indus-trialization to informatization and are still pushing forward the frontiers of modernization marked mainly by informatization. Some NICs - Korea, Singapore, Hong Kong and Taiwan - have opted for simultaneous industrialization and infonnatization. Their example is being followed by some other developing countries - Malaysia, Indonesia and Thailand, for example.

Options, Opportunities and Constraints

Lagging behind in both industrialization and informatization, most developing countries are now faced with a very unfavorable situation. While the developed countries, already industrialized, are free to concentrate their efforts on the development of informatiza-tion, the developing countries are still in the early stages of indus-trialization with a double task at hand. If they cannot accelerate their pace of industrialization and infonnatization, the gap between developing and developed countries will continue to widen.

In order to speed up the narrowing of this gap and to lay the foundation for closing it in the

future, the developing countries have to answer a strategic question of great significance: how will they handle the relationship between informatization and modernization?

Three Options

There are many different views on this question. One of these views advises the developing countries to sidestep the traditional stage of industrialization and enter directly into modernization via informatization. Another view holds that it is too early for the developing countries to opt for infonnatization, which will be pos-sible only when they have completed their industrialization. Accord-ing to this view, what they should do is to apply advanced technolo-gies to the transformation of traditional industries. There is a third
opinion which advises the synchronous development and mutual promotion of informatization and industrialization.

The choice of which of these three directions to take will be a strategic one for any developing country. To opt for the first choice, that is, informatization without industrialization, will certainly separate a developing country from reality. Historical experience has shown that informatization cannot be achieved without an industrial foundation.

A strategy based on the second point of view - applying informatics to traditional industrialization - is also unworkable. Such a strategy will slow down the pace of informatization in the developing countries and enlarge the gap between them and the developed countries. Experiments with this stmtegy have already pushed some of the developed countries backward in terms of informatization. This should serve as a lesson to the developing countries.

A strategy chosen in accordance with the third view - simul-taneous informatization and industrialization -can lead to the rapid development of both informatization and industrialization. Current examples of this strategy have proved both effective and successful, allowing the NICs and some developing countries to narrow the modernization gap.

One common problem the developing countries face at present is how to adapt their socioeconomic development strategies to emphasize the promotion of informatization. Another challenge is to formulate an informatization development strategy which is fully effective. To reach an appropriate solution of this problem, devel-oping countries must be fully aware of the significance of infor-matization in modernization, understand its challenges and cons-traints, and suggest measures for informatization development in accordance with national reality.

Opportunities

The informatics revolution creates special opportunities for the developing countries to accelerate their pace of economic and social development.

Economic Development: The informatics revolution means a better integration of information with the three major productive
factors (labor, capital and technology). Such an integration enables workers to enhance their productive capacity, enlarges the utilization ratio of capital and spreads the benefits of technology. Productivity, quality, competitive power, the growth of new products, technical transformation of traditional industries, and energy and material savings are all enhanced by informatization.

Social Development: The infomratization of decision making and social management can

help developing countries find better solutions to social problems, spread the benefits of education and health, preserve the environment, streamline the administration and generally lead to faster social development.

Scientific and Technological Development: The informatics revolution can accelerate the development of science and technology in the developing countries by expanding scientific research related to informatization, by promoting a combination of informatics with traditional skills and appropriate technologies and by undertaking technical innovations and inventions in the application and use of information resources.

Human Development: The informatics revolution provides new tools for education, training and communications, such as audio-visual equipment, computer-supported instruction, and satellite broadcasting and communication channels. By using these infonnatized tools, the developing countries can enhance educational levels, train more qualified personnel, raise the standard of scientific and cultural attainment and promote human development.

Challenges and Constraints

The informatics revolution and informatization offer the developing countries many possibilities, but they do not guarantee the realization of these possibilities. The realization of these possibilities depends on the developing countries' awareness of the serious challenges they face, on their correct appraisal of their constraints, and on their ability to determine workable goals and adopt concrete measures for their attainment. Developing countries vary in their specifics, but some similarities in terms of the challenges and constraints they face can be identified:

a) In catching up with the developed world, there is much ground to cover.

b) The gaps are multiple: in technology, economy, society, cultural life, etc.

c) The main targets for improvement are backward productive structures, outmoded management and decision-making models, inferior competitive power and lower educational and living standards.

In respect of constraints faced in developing informatization, developing countries share many similarities:

a) A weak foundation of informatization. The size of deve loping-country information sectors is small, with a proportion of under 25 percent, as compared with 40-65 percent in the developed countries. Developing countries are short of such basic installations as public communication networks, integrated circuits and computer industries.

b) Backward scientific and technological levels and weak research and development capacities.

c) A shortage of well-trained informatics personnel.

d) Insufficient capital and foreign exchange and inadequate investment in information-sector industries.

Coals and Measures

a) Developing countries must simultaneously pursue the goals of informatics and information industry development and other socio economic development goals.

b) They also need to combine short-term with long-term goals. Short-term goals include the application of informatics technologies which can be used and popularized immediately and which can produce swift technological transformations. New informatics

products that are able to open up domestic and international markets and to enhance competitiveness with imported products should be encouraged. New information enterprises which can exploit, utilize and circulate information should be a development priority. Informatics personnel must be educated and trained. Information support systems to serve decision making and management are crucial. All
these goals should be linked with, and lay a good foundation for, the realization of long-term goals. Long-term goals include predicting future informatics needs, educating and training the appropriate professionals, accelerating the penetration of Informatization into all aspects of productive, social and cultural life, increasing the share of the information sector and enlarging information circulation and information networks.

c) When setting goals for Informatization development, the developing countries need to coordinate these goals with those of appropriate technology development in order to. satisfy actual local needs. Informatization must not be pursued at the cost of sacrificing the necessary appropriate technologies. Rather, it should support or transform local appropriate technologies and traditional skills.

d) Developing countries need to set limited goals for Informatization and to set development priorities according to the realities of capital, equipment and human resources. Overambitious goals are not only beyond the capacity of developing countries, but are also bound to disperse their strength and lead to negative results. Priority goals should include the satisfaction of basic human needs and should serve human development.

Measures which developing countries should take to develop
their Informatization capacity. include the following:

a) The development of Informatization should be brought into line with overall socioeconomic development and regional cooperation plans. Many developing countries have already started coordinating Informatization development with the development of manpower, capital and equipment. They have also begun to analyze their situation, assess the possibilities and select priorities for development in terms of technology, economy and social benefits.

b) Investment in the exploitation, utilization and development of informatics and the information sector must be increased by slowing down the pace of traditional industrial development, providing new funds for development or using foreign capital.

c) The construction of public communication networks,
integrated circuits, computer industries and other basic installations needed for informatization should be expanded in order to increase the number of televisions, tele-phones, computers and microprocessors.

d) Projects to educate and train informatics personnel are already being executed in some developing countries, including in-service training of technical personnel.

Infonnatization and the North-South Relationship

The informatics revolution and the development of informatization are often regarded as a threat to the developing countries which will further enlarge the gap between North and South, Two important ways to remove the threat and narrow the gap are (i)
expanding the exploitation of informatics by the developing count-s tries to speed up their course of informatization; and (ii) strengthen
ing North-South cooperation and relationships in the course of global

informatization. A rational relationship between the North and the South is obviously beneficial to the growth of informatization in the developing countries. Better North-South cooperation is needed in dealing with the following issues:

a) Establishment of a new informatics order between the North and the South. The South must at present import the necessary informatics products to accelerate the development of infon atization; the North must promote the transfer of informatics and create the conditions for informatics cooperation.

b) Provision of more marketing opportunities for the developing countries to improve informatics product trade between North and South. Only through deliberate efforts will the pattern of the North as supplier and the South as consumer of Such products be gradually changed.

c) Strengthening North-South cooperation in the development of infornatization. Such cooperation could be carved out through all kinds of channels: informatization education, informatics personnel and employment training, the utilization and popularization of informatics products, the exchange of professionals, informatics consultation and service, the setting up of information networks and cooperative research.

d) Extension of the North-South dialogue to include informatization development. Such dialogue contributes to the enhancement of informatization awareness and an understanding of the future of informatization. Strategic decision making for informatization growth in the developing countries and the improvement of North-South relations is a mutual responsibility of North and South.

Current and future trends in North-South relations will affect future patterns of global informatization. Assuming a good relation ship between North and South and swift informatization develop ment in the South, we can predict future trends in global informati zation.

In the short term, developing-country governments will pay greater attention to the formulation of informatization development, application and servicing and to the construction of information networks for administration and management. Corresponding goals and measures will be designed and put into effect in order to lay a foundation for informatization. In the developed countries, one clear trend is the formation of informatics monopoly groups, of which the core is the transnational corporations, financial and banking groups. Such monopolies pose new threats and challenges to the developing countries.

In the medium term, the shift of the world's economic center to the Pacific region will be accompanied by the development of this area into a world informatization center. This area will be the first to successfully close the informatization gap between the North and the South.

The long-term future of informatization will unfold in the coming century. The key to this future is the pace of informatization growth in thee developing countries. If we use the changing size of the information sector and the penetration of informatics products as our measure and take the 1970s as our starting point, we can forecast that the informatization gap between the developing and developed countries will be bridged by the middle of the next century. In the 1970s, the developing countries had very small information sectors, but by the 1980s the situation had changed dramatically. In China, for example, the annual total output value of the computer industry between 1980 and 1985 rose by 2.5 times. The number

of technical personnel in the computer industry reached 107,000. The uses of computer application have surpassed 20,000. Computers installed
number more than 7,000 and there are 130,000 microprocessors. In respect of domestic computer production, computers total 1,455, microprocessors 70,000 and peripheral equipment 109,000. Meanwhile, from 1978 to 1983, the total volume of post and telecommunications business increased by 94 percent. Television viewing in cities is as high as 93 percent and in rural areas, I 1 percent. If such a tempo of development can be maintained into the next century, the future of informatization in China will be bright.

Policy Options

The study of informatics and informatization development has rapidly gown into a worldwide activity. More and more institutions and organizations have engaged in development research on informatics and informatization, including BOSTID, the Commonwealth Working Groups, IBI, IDRC, ILO, ATAS, UNESCO, UNCTC, UNCTAD, UNFSSTD and UNIDO. Similar research is also being carried out in individual countries, including developing countries. The North South Roundtable, by holding meetings in cooperation with many international and national organizations, encourages global discussions on the subject. These and many other signs are an expression of the world's awareness and concern.

The study of infonnatization development strategy outlines policy options and serves development decision making at the national, regional and international levels. Working out a development strategy for informatics and informatization conforming to a country's national reality has an important bearing on its prospects and future. The developing countries must undertake studies and work out practical development strategies for informatics and 'formalization before it is too late.

The following eight elements will contribute to effective de vision making:

a) A system of technical references. The systematic collection of informatics materials and data will help policy makers to understand what is required for the research, development, utilization and popularization of different informatics applications and to set goals and priorities in informatics development.

b) Learning by experience. A systematic study of successes
and failures should guide the informatics choices of developing countries.

c) Awareness of the environment. Both the domestic and the international environment should be described in terms of favorable and unfavorable conditions for the development of informatics.

d) Appropriate decision-making structures. The selection and formation of a decision-making group is one of the most important factors influencing successful decision-making on informatics development. It is essential to establish a set of decision-maker references to avoid decision faults due to an inappropriate selection and formation of such groups.

e) A prioritized system of goals. The goal of informatics development is only one among many goals of socioeconomic development. The other goals should function as points of reference for the goal of informatics development, which should contribute to the achievement of these goals.

f) Awareness of different theories, methods and approaches. An informatics development strategy should be formulated by experts from different disciplines who apply different theories and approaches.

g) An attempt at forecasting the future. A strategy to develop informatics would be blind if

it did not base itself on future trends and make an early attempt to predict and cope with changes.

h) Willingness to test possible solutions. One guarantee of successful decision making is to test and demonstrate an idea before putting it into wide effect. Criteria such as necessity, feasibility, technical quality, comprehensiveness, rationality and flexibility should guide decision making and eliminate flaws in plans.

According to a Chinese proverb, "A thousand-li journey is started by taking the first step." Taking strategic decisions on informatics and informatization development can be considered the first step of a long journey by developing countries toward infonnatization and modernization. If the first step is a sound one, the course of development can be steady and swift right from the beginning.

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PART III
POLICY ISSUES FROM DEVELOPED-COUNTRY PERSPECTIVES

CHAPTER 12
New Information Technologies: Expanding the Informatics Frontiers

Jean V. Salmons

The development of new information technologies is a basis fact a new revolution within the informatics revolution. What makes it new revolution is that its main features and effects are very different from those of classical computer tools, and it is bringing about greater changes in economic and social life than classical informatia technologies have ever effected.

New information technologies have a few characteristics whit make them drastically different from classical information technolc gies. They are light and flexible, relatively cheap, easy to acquire an very easy to use. They are fully user oriented, which means most c them can be operated after a short period of training by a user who i not familiar with computer technologies and who has no ability, ft instance, to program. They penetrate the day-to-day fife of hid. viduals in their work and in their private life, and therefore, they are changing behavior, organizational structures, working procedure and, little by little, the way economies and societies are operating.

Classical information technologies were heavy, expensive intimidating to use and complex to operate. Thus their introduction was generally centralized. Regardless of the role of governments, this introduction was monitored jointly by hardware and software manufacturers and computer specialists. Generally, classical info oration technologies did not bring about major changes in organza tonal structures and operational procedures in either public admen station or business. Neither did they change behaviors. In fact, ii most cases, apart from scientific use, the use of classical information technologies has mainly consisted in the automation of ahead: existing manual procedures. Gradually, computerization has become conservative. By using technologies which implied heavy investment and which did not evolve easily and by creating a new power-the power of informatics specialists-it became even more difficult that

previously to change organizational stmctures and to alter existing procedures. New information technologies are changing that situation.

The New Technologies

The new information technologies which are spreading fastest and which are going to bring about the most drastic changes - for example, microprocessors - are complex and sophisticated technologies, yet the products based on these technologies are friendly and even trivial. For instance, microprocessor card technology is a very high-level one, but microprocessor cards are currently used in public phones and thrown away after use.

Among the new technology products are microcomputers, intelligent telephone and communication systems, multitechnique work stations and local area networks, videotext, mass on-line electronic data storage devices, microprocessor cards and expert systems.

Microcomputers and Related Software Packages

Due to their low prices and to the existence of de facto standards, personal computers are penetrating the day-to-day life of most white-collar people at work and at home in developed countries. Almost every individual within a few years will be used to a word processing package, a spreadsheet and a database Fourth Generation Language. Businessmen as well as salesmen use portable PCs which they can plug into the telephone network at any time of the day and even in the evening, at home or in their hotel rooms to send reports to their offices and transmit orders from their clients. With their word processing and spreadsheet packages, they can prepare reports and graphics which will be disseminated directly in a near-published quality form with the use of a laser printer at the office, or put at the disposal of those for whom they have been prepared through a terminal access network.

Intelligent Telephone and Communication Systems

These services, offered by both telephone and network companies and by corporate PBXs, include automatic transfer of telephone calls, conference calls, audio and video conferencing and vocal
messages. New networks (especially those using optical fiber) are now capable of transporting data, voice and image at the same time. Telephone networks are already being widely used to transport data with such techniques as videotex, teletex and facsimile transmission.

Multitechnique Work Stations and Local Area Networks

At the office, microcomputers play the role of both a personal computer for local use and a terminal with access to internal and external information systems. These micros communicate through local area networks (LANs), which make it possible to exchange information between individuals and to have access to some common equipment such as a laser printer, a mail processing minicomputer, a mass storage laser disk system, etc.
Combined with intelligent telephones and video equipment, these technologies constitute multitechnique work stations through which the individual, at the office as well as at home, can have access to all types of information he needs, store his own information and communicate with other individuals and institutions.

Videotex

Videotex is a standard which makes it possible to use cheap terminals (US$ ISO) and the telephone system to access data banks and to exchange messages. In France, for example, the telecommunications agency gives one videotex terminal free of charge to all enterprises and households for each telephone line, which makes it possible to access thousands of services offered by specialized companies and agencies - electronic telephone directories, airline and train timetables, stock exchange rates, theatre and cinema schedules, mail-order companies, electronic message systems, bank account operation, etc. The cost per use is very low, but the service is so attractive that the market is large, making it possible for the telecommunications agency to keep on investing and for specialized electronic service companiess to make a profit. In France, there are now many thousands of such services offered.

Mass On-line Electronic Data Storage

The new laser disk technology has considerably increased the
storage capacity on a 30-centimeter disk and generates two major applications: distribution on CD ROM of large amounts of information with little or no updating needed (such as encyclopedia, dictionaries, collections of photographs, etc.), and storage on juke boxes of laser disks of very large quantities of data (e.g., the incoming mail of an insurance company), for which on-line access is necessary.

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Expert Systems

The technology of expert systems makes it possible, in any field where an expert is generally needed, to guide a nonexpert user in finding the solution to a problem (e.g., in medical diagnosis, law, etc.). Thus it disseminates the knowledge of experts, making an expert of any individual who uses the expert system.

Other Technologies

These include production, monitoring and control informatics, computer-aided design, computer-aided education and robotics, all of which significantly increase the productivity of the tasks to which they are related.

Implications of the New Technologies

Information systems are now clearly divided into three categories: (i) individual infomtation systems, which are built and used by one individual; (ii) small and medium-sized information systems, which are generally used, for instance, within a corporation; and (iii) large or very large information systems, which are built and used Gains in productivity through new information technologies can be measured. More generally, new information technologies can be submitted to cost-benefit analysis.

Mass production of products based on new information technologies requires smaller investments, including research, than do mainframe computers. Therefore, many new manufacturers are appearing on the market. From an oligopolistic situation, we are moving toward a full competition market for hardware as well as software, which explains the continuous decrease in prices. Another result of the new information technologies has been the development of a new sector of enterprises - computerized information services.

As for human resources, there is now a concentration of informatics professionals in hardware and software manufacturing companies and in companies specializing in computerized information services. In public administration and private firms, there has been a dramatic reduction in the number of computer specialists employed due to the new user-oriented technologies, while the same firms and public administration services now require a new category of specialists - network managers and operators.

We will not elaborate on changes in day-to-day life, as this has already been thoroughly discussed in many publications. But it is worth noting that the significance of human relationships in the transaction of business is declining.

Main Issues

During the past decade, the main issues related to computerization in developed countries were (i) the need for computer specialists and related training; (ii) national independence from

multinational hardware manufacturers and aid to domestic firms through protectionist regulations; (iii) privacy; (iv) standards; and (v) transborder data flows.

The new issues are rather different. The most important of them relate to the training of the users - effectively, the whole population, adults and children - and to the monitoring of economic and social changes caused or accelerated by the introduction of new technologies.

New information technologies are changing society and the economy. At the same time, related activities will play an increasing role and represent a greater share of the gross national product.

The role of users, i.e., enterprises and individuals, will be predominant, as opposed to the first phase of computerization, which was dominated by manufacturers and informatics professionals.

The problems which are being raised by these new technologies are no longer technical nor even psychological, but mainly sociological and especially organizational.

One of the main issues at the international level remains the fact that these new technologies have been designed and are being used first in industrialized countries, where the major changes they are bringing about in these economies and societies are clearly visible. Now, all these same technologies are beginning to be used in developing countries. Will this use inevitably contribute to development, or is there cause for hesitation by countries which have not yet taken the first steps? Does the introduction of new technologies in developing countries require a government policy and government regulation? Even before these questions are answered, developed-country fins will be pushing for quick informatization by developing countries because they are interested in profits. Under what conditions will these new technologies bring more benefits than disadvantages to a given developing country?

These are among the major questions which the international community should raise. They are much more important than issues of privacy, transborder data flows, ate., which are neither relevant to the new technologies nor urgent for developing countries.

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The technology of expert systems makes it possible, in any field where an expert is generally needed, to guide a nonexpert user in finding the solution to a problem (e.g., in medical diagnosis, law, etc.). Thus it disseminates the knowledge of experts, making an expert of any individual who uses the expert system.

Other Technologies

These include production, monitoring and control informatics, computer-aided design, computer-aided education and robotics, all of which significantly increase the productivity of the tasks to which they are related.

Implications of the New Technologies

Information systems are now clearly divided into three categories: (i) individual infomtation systems, which are built and used by one individual; (ii) small and medium-sized information systems, which are generally used, for instance, within a corporation; and (iii) large or very large information systems, which are built and used

national enterprise register). Large information systems are now built to be shared among many people and organizations, which makes possible their entry into the market system, whereas previously they were confined to government use and financed by taxpayers.

As a result of the introduction of the new technologies, a few occupations are already disappearing from society: typists and even secretaries, switchboard operators, chain workers and documentalists. In France, for instance, the dissemination of the videotex telephone directory has resulted in a reduction in the number of telephone operators who give information to the public.

Corporations have gained great freedom in locating jobs which mainly process information. These tasks can now be performed almost anywhere, including at home, which opens the way for part-time home employment, especially for women. Corporations which process information can likewise be located anywhere.

Paper is disappearing little by little. At the same time, the transmittal of information is swifter than before, not only for access to data, but even for current mail. In most enterprises now, urgent mail is sent via facsimile transmission rather than by post or messenger.

The time between ordering goods and services and paying for them has been reduced, which increases the pace of the economy by saving time and by increasing the speed of money circulation. Audio and video conferencing reduces travel costs and makes meetings easy to organize.

Changes in organizational structures have begun to appear, as opposed to the earlier informatics generation's reinforcement of traditional structures. New structures are needed to adapt to the new types and the increased speed of information circulation. After an, an organizational structure is nothing more than a graph of information flows and storage. But the changes are not spontaneous, and more effort is needed to create new types of organizational structures. For instance, in most countries, the geographically-defined administrative areas have not changed since the time when the only means of transporting information was by horse! And while the ways of storing and transmitting knowledge, as well as the possibilities for teaching, have become greatly diversified, the organizational structure of education is still based on classroom instruction, a system created more than two thousand years ago.

Gains in productivity through new information technologies can be measured. More generally, new information technologies can be submitted to cost-benefit analysis.
Mass production of products based on new information technologies requires smaller investments, including research, than do mainframe computers. Therefore, many new manufacturers are appearing on the market. From an oligopolistic situation, we are moving toward a full competition market for hardware as well as software, which explains the continuous decrease in prices.
Another result of the new information technologies has been the development of a new sector of enterprises - computerized information services.
As for human resources, there is now a concentration of informatics professionals in hardware and software manufacturing companies and in companies specializing in computerized information services. In public administration and private firms, there has been a dramatic reduction in the number of computer specialists employed due to the new user-oriented technologies, while the same firms and public administration services now require a new category of specialists - network managers and operators.
We will not elaborate on changes in day-to-day life, as this has already been thoroughly discussed in many publications. But it is worth noting that the significance of human relationships in the transaction of business is declining.

Main Issues

During the past decade, the main issues related to computerization in developed countries were (i) the need for computer specialists and related training; (ii) national independence from multinational hardware manufacturers and aid to domestic firms through protectionist regulations; (iii) privacy; (iv) standards; and (v) transborder data flows.
The new issues are rather different. The most important of them relate to the training of the users - effectively, the whole population, adults and children - and to the monitoring of economic and social changes caused or accelerated by the introduction of new technologies.
New information technologies are changing society and the economy. At the same time, related activities will play an increasing role and represent a greater share of the gross national product.
The role of users, i.e., enterprises and individuals, will be predominant, as opposed to the first phase of computerization, which was dominated by manufacturers and informatics professionals.
The problems which are being raised by these new technologies are no longer technical nor even psychological, but mainly sociological and especially organizational.
One of the main issues at the international level remains the fact that these new technologies have been designed and are being used first in industrialized countries, where the major changes they are bringing about in these economies and societies are clearly visible. Now, all these same technologies are beginning to be used in developing countries. Will this use inevitably contribute to development, or is there cause for hesitation by countries which have not yet taken the first steps? Does the introduction of new technologies in developing countries require a government policy and government regulation? Even before these questions are answered, developed-country fins will be pushing for quick informatization by developing countries because they are interested in profits. Under what conditions will these new technologies bring more benefits than disadvantages to a given developing country?
These are among the major questions which the international community should raise. They are much more important than issues of privacy, transborder data flows, ate., which are neither relevant to the new technologies nor urgent for developing countries.

CHAPTER 13
Telecommunication Technologies and their Impact

Hideyoshi Tominaga

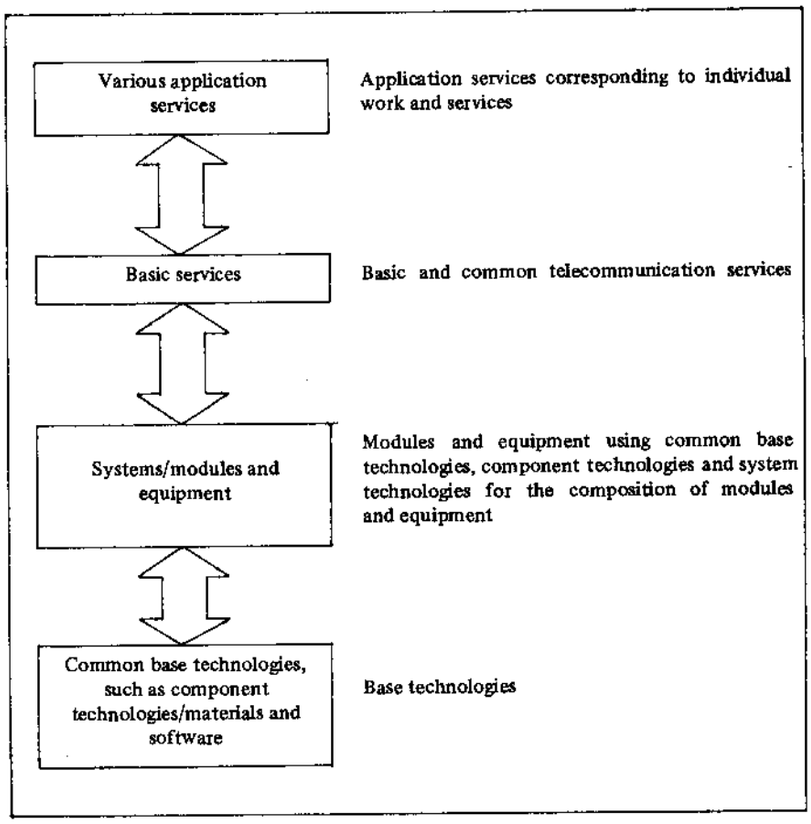
Telecommunications play an extremely important role in the formation of an advanced information-oriented society. The appearance of such a society in the twenty-first century implies profound changes in social requirements and the emergence of new social problems.

Telecommunication Technologies

The existence of technologies enabling concrete plans for advanced telecommunication services to be envisaged underlines the high expectations of an advanced information-oriented society vis-a-vis the satisfaction of diverse requirements. Technologies resulting in new telecommunication services can be classified in two ways. As shown in figure 1, the first classification corresponds to different levels of technological integration, such as basic research objectives regarding principles, technological system, units of component technologies, system technologies (including systems/modules and equipment based on a combination of component technologies), and those technological systems providing actual services with the use of system technologies.

FIGURE 1

Types of Telecommunication Services and Technologies



The application system (service) level refers to such individual services (systems) as a local health care information system, a home banking system (service) and a production control network system which embody certain specific functions. In comparison, the basic service (system) level refers to such basic and common telecommunication services (systems) as a personal computer communication service, electronic mail service, etc. The systems/modules and equipment level refer to such equipment (hardware) and software as optical switchboards and network architecture used to achieve basic services and various application services. The common base technology level corresponding to component technologies/materials and software refers to those materials and elements which the above services and systems are composed of, basic technologies such as pattern recognition, voice recognition and display, and a group of basic technologies, e.g. languages.

The second classification is based on the levels of communication functions, such as a telecommunications system with a two-way character, a broadcasting system with I:N communication, and relatively new information services through databases. Telecommunication technologies can be systematized, as shown in figure 2, with combinations of different levels.

The basic services consist of six service groups: telephone, telegraph, data, image, mobile and broadcasting. The systems/ modules and equipment are classified into terminal systems relating to image and voice, network systems (including network architecture, exchange, transmission and communication processing), satellite and radio systems, data processing systems, etc.

FIGURE 2

Types of Telecommunication Services and Technologies

Basic Services Systems/Modules and Common Base Technologies Equipment

		o Image or voice/display Methods
	Terminal systems (voice, image, etc.)	M,n-znacltine bases Network bases
	Network systems	Optical communication Bases
	- Exchange	Communication Methods
o Telephone	- Transmission	_ Transmission
O Telegraph	- Network arc-Lecture	Materials
o Data	- Communication	- Elements
o Image	processing	o Security bases
O Mobile	o Satellite and radio	O Satdtite communi
o Broadcasting	systems	cation bases
	o Broadcasting systems	o Broadcasting bases
	o Data processing sys-	O Elements and sensors
	temt (hardware and	
	software)	o New mkaodectronics
	o Others	o Software and languages

The common base technologies can be classified into image or

voice/display methods, man-machine bases, optical communication bases (optical communication methods, transmission materials for optical communication and optical elements, etc.), security bases, satellite or mobile communication bases, broadcasting bases, ele ments and sensors, new microelectronics and software and languages, etc.

The Light and Dark Sides of IT

Telecommunications have the potential to introduce efficient decision making, through which society can be democratized. They also allow the substitution of material properties by information and the conquest of time and space. Moreover, there is also the possibility that information itself may, depending on the contents, form a new culture. These possibilities relate to the expectations for both qualitative and quantitative improvements in all aspects of society, i.e., greater efficiency, the promotion of diversification and decentralization, the full development of creativity and personality, and the promotion of common ownership, improved convenience and an increase of employment opportunities.

Concern is, however, simultaneously expressed over new social problems originating from such developments in telecommunications as the spread of information communication equipment and advanced networking. To be more precise, these problems are the emergence of gaps due to the uneven distribution of information, the shift toward a regimented society due to the suction of information through the networks, and the increased vulnerability of network systems due to their enlargement. These problems can be described as the adverse aspects of the introduction of efficient decision making.

While these possibilities and problems represent reverse sides of the same coin, i.e., the light and dark sides of an advanced information-oriented society, the social requirements of telecommunications reflect the dual character of informatization and, as table 1 shows, the contents differ depending on the ideal of the advanced information-oriented society to be

TABLE 1

Light and Dark Sides of the Social Requirements of Telecommunications

Light		Dark	
Changes in Social Requirements		Changes in Social Requirements	
Example	Characteristics	Characteristics	Example
○ Local autonomy may be promoted due to the facilitation of major information communication processing at a community level.	Participation, decentralization.	Control.	○ Information control may be advanced due to the shift towards a network system, where information is sent via the nerve center. ○ Individual anonymity may be lost due to the introduction of a personal identification number and other systems. Control over the people will be strengthened.
○ Decentralization to various regions may be promoted due to the possibility of information networking and decentralization.	Decentralization.	Centralization.	○ Nerve centers for each industry may emerge, forming an industrial complex. ○ Due to the suction of information, major functions may be centralized, accelerating the centralization to urban areas.
○ Individuality and self-realization may be promoted.	Creative and advanced selection of information.	Emergence of techno-stress and uniformity.	○ Homogenization may result from the facilitation of packaged information.

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The promotion of participation and decentralization opposes control and centralization. Similarly, the development of individuality and the promotion of self-realization based on multiple options, diversification and communalization based on informatization oppose an increase of techno stress, the spread of uniformity ad the emergence of various gaps. The relationship between the light and dark sides is not uniform, but is a complicated causal relationship where the development of the light side may overcome the problems of the dark side, or where stress on the fight side may inevitably lead to the emergence of shadows. In addition, it is certain that the relationship will be seriously affected by the types of telecommunication technology systems to be developed in the future and their operation methods.

Telecommunication technologies are, therefore, expected to play a number of roles in the formation of the light side of an advanced information-oriented society. Thus measures to deal with the dark side of this society must be anticipated. As social problems cannot be fully resolved by technological measures in the telecommunications field, approaches from various directions, including legal measures and social responsibility, will be necessary.

The Light Side

The main social requirement for telecommunication technologies in an advanced information-oriented society will be the coexistence of two functions, i.e., diversification/advancement and high efficiency/rationalization. Table 2 shows the roles expected to be played by

telecommunication technologies in the formation of the light side. Not only diversification and advancement in terns of turning assets into highly value-added assets by using information, finance and distribution to enhance national life (including education, culture, leisure and medical services), but also high efficiency and the rationalization of industrial production, distribution, sales and management are demanded as the most important functions of telecommunication technologies. To fully exploit human creativity, internationalization, decentralization and homogenization (via the rectification of various gaps), safety, energy and resource conservation must be achieved on the basis of economic progress and increased efficiency.

The major tasks for telecommunication technologies in the realization of the various application services required by society can be summarized as follows:

a) Realization of ultra-fast, large-capacity communi
cation networks.

b) Realization of diverse advanced telecommunication
services.

c) Realization of advanced broadcasting services.

d) Realization of infrastructure for home informatization.

First, such technologies as optical transmission, satellite and exchange technologies enabling the establishment of ultra-fast and large-capacity communication networks are required. Telecommunications have been traditionally considered to be a social infra-structure with a public character from the viewpoint of communication privacy, fair services and national security. The establishment of these communication networks will, therefore, not only secure the advancement and smooth acceptance of various services by society, but will also act as the basis for the realization of various application services. As these networks will be huge and not easily renewable once established, their technological systems must satisfy long-term requirements.

Second, there is a group of technologies to realize the various telecommunication services to be developed over and above the infrastructural and technological tasks shown in table 2. A wide range of technological developments, from terminal and communication processing technologies to information provision through databases, is expected to take place.

Third, technologies for the realization of advanced broadcasting services are required. As in the field of telecommunication services, advanced services, including teletext, are already being provided in the field of broadcasting services. However, the provision of more advanced broadcasting services to satisfy diverse requirements, not only for entertainment and leisure purposes but also for educational, cultural and welfare purposes, is required. Moreover, the requirements for improved visual and audio qualities and for multiple channels must be catered for.

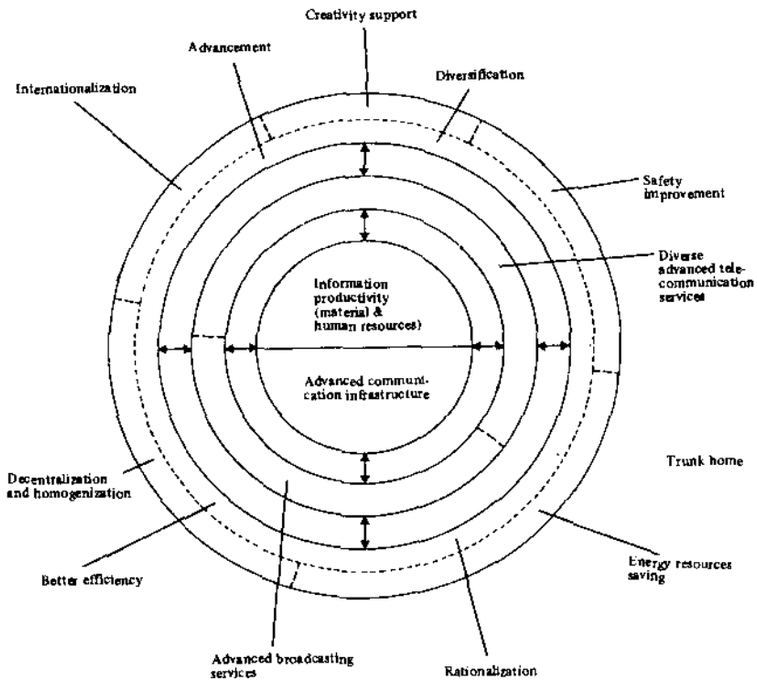
Finally, a number of technologies to facilitate home informatization are required. One of the main characteristics of an advanced information-oriented society is the density of informal information exchange between communities and individuals via telecommunication networks. Multifunction terminal equipment and information exchange services must be provided for easy use at low cost in order to facilitate home informatization.

As shown in figure 3, the light side of an advanced information oriented society is formed through the development of an advanced trunk communication infrastructure, the introduction and spread of information communication equipment to households, and the various advanced telecommunication and broadcasting services which are developed based mr a competent infrastructure and equipment. High information productivity, which is considered a fertile intel-

lectual resource, forms the background for such a development.

FIGURE 3

Telecommunication Technologies Expected to Contribute to the Formation of the Light Side of an Advanced Information-oriented Society



The Dark Side

The negative effects of the dark side of an advanced information-oriented society which may result from the introduction and spread of information communication equipment and its networking must be anticipated. Possible social problems include:

a) Increased vulnerability of social functions due to networking. The social vulnembility to natural disasters, malfunctions, crimes, errors and disoperation, etc. may increase.

b) Increased requirement for privacy protection. Strong privacy protection may be necessary to prevent the improper use of personal information. However, this privacy protection may eventually hamper the efficient utilization of personal data through computer processing and networking.

c) Unsatisfactory external effects of information. Delays in terminal connection or the inability of terminals to provide access to diverse information may result in unsatisfactory information external effects.

d) Emergence of various gaps. Regional gaps concerning information infrastructures, information gathering and processing gaps due to economic strength, and new media dropouts due to information illiteracy may emerge. A gap may also emerge between those providing services and consumers due to the progress of informatization (creating a question of consumer protection).

e) Intensified conflict of interest. Conflicts of interest concerning information ownership rights and other aspects may be intensified by the increased value of information.

f) Personality distortion and other problems due to occurrence of techno-stress. Such social problems as maladjustment to information communication equipment, the occurrence of stress following an increased demand for intellectual work, and an excessive adaptation to informatization may appear. Decreased personal communications may result in a deterioration of the thought faculty, knowledge fragmentation and other adverse effects.

g) Standardization of information and spread of useless information. Standardized or useless information may be excessively spread in such fields as education, culture and leisure.

h) Occurrence of information overflow. An excessive volume of information to which people cannot properly react due to too many options may result in information pollution.

i) Information manipulation. Decision making in political and consumer movements may be distorted due to the manipulation of information, accelerating the control and centralization by means of informatization.

j) Low information productivity. Information production activities, including the preparation of computer software, cannot enjoy scale merits. Productivity will not be improved due to a lack of repeat orders and the difficulties of manual preparation, affecting the overall productivity of information-related activities.

k) Adverse effect on employment. Employment may be affected by electrification. and mobilization in the production process, particularly in the secondary industries, and by office automation and the networking of administrative work.

I) Mismatch with existing legal system. The introduction and spread of new media services may cause a mismatching with communication-related (telecommunication, broadcasting and radio monitoring), commercial, civil, educational, medical and pharmaceutical laws and systems.

Two measures may mitigate the negative effects of the new technologies. First, a comprehensive assessment is required in advance in order to determine what impact the development and introduction of technologies, systems and services will have on a society, taking into consideration the desired developmental direction. In other words, a technology assessment must be conducted. Second, the possibility of technological solutions to social problems must be examined. As well as comprehensive measures to raise people's consciousness in terms of legal systems and social customs, the possibility of technological solutions and their limitations must be clearly understood. Social problems which may respond to technological solutions include: (i) the increased vulnerability of social functions due to networking and the increased requirement for privacy protection; (h) the unsatisfactory external effects of information; and (iii) the emergence of various gaps due to informatization.

Privacy Protection

Technologies will play a major role in the solving of such problems as mechanical failures,

accidents resulting from personal carelessness, and natural disasters. In addition to improved reliability and safety, not only prevention technologies (including a fail-safe mechanism based on the study of the mistake mechanism), but also remedial technologies for network protection, network control, and terminal and host protection must be developed. With regard to deliberate crimes, such as network crime, security technologies which include coding, personal identification, information flow control and inference control must be developed, together with the relevant development of communication facilities, an appropriate legal system, and education in terms of nurturing the relevant ethics.

As far as the problems of social vulnerability and privacy protection are concerned, a tradeoff exists whereby the provision of a network at a given cost based on a current technological system will increase vulnerability. Therefore, the development of telecommunication technologies to establish a low-cost security system is absolutely necessary. In addition, a consensus based on a wide range of opinions must be sought on guidelines for the required degree of safety.

As security measures employed by banks demonstrate, the cost of security can be borne by both the clients and the organization.

Nevertheless, in a networked society, even if one part of society improves its security, other parts may not necessarily follow suit. In addition, it may be difficult for any one section of society to bear all the privacy protection and other costs. Therefore, governments will play an important role in the preparation of technological standards and the development of security technologies, especially where the cost-benefit factor is of importance.

With regard to privacy protection, coding technologies, personal identification technologies, information flow control technologies (for example, access is terminated when a dubious input is made) and inference control technologies (making it impossible to infer someone else's password) should be developed in order to prevent the dishonest use of personal data and to properly maintain and control data. As the monitoring of information accuracy regarding collected personal data will, however, have technological limitations, appropriate legal provisions, standards, and an educational system to ensure the high moral standards of those handling data should be introduced.

Emergence of Gaps

The possible gaps which may emerge following an increased volume of information are (i) regional gaps, including a North-South gap in the field of international information flow and gaps between domestic regions, (ii) gaps due to different levels of information gathering and processing capabilities, and (iii) gaps caused by information illiteracy.

With regard to gaps of an international nature, telecommunication and broadcasting facilities corresponding to the requirements of developing countries in terms of their stages of economic development and local customs should prove extremely useful in closing these gaps. Technologies relating to satellite communication, databases and automatic translation, etc., should also be extremely useful. On the domestic front, a technological response to the provision of fair services in terms of a standard charge rate and simultaneous communication is one solution. In addition, technological developments to bring about lower communication costs will be required.

Gaps originating from different levels of information gathering and processing capabilities include gaps between industries, centralization and monopolization of information by specific groups, and gaps in terms of the response capabilities of; for example, large and small companies based on their financial and manpower strengths. Serious problems will also be caused by gaps between those providing information and those receiving it, as the progress of infornatization will further advance the advantageous status of the provider. Since consumers engaged in home shopping or home banking lack the ability to support their complaints or legal cases (the provision of evidence against the credibility of information offered), and since consumer control can be intensified by the adoption of favorable data by those offering information, measures to deal with these problems must be introduced.

It is important that simultaneous access to information (the availability of the same information at the same time for all) and a standard low-charge system be secured to solve the problems originating from gaps, in turn caused by different levels of information gathering and processing capabilities. Therefore, tasks regarding technological development include the establishment of networks, the manufacture of terminal equipment, and development of those general telecommunication technologies which will enable a reduction in user charges for such information as databases.

With regard to the widening gap between the strong, i.e., inform
nation suppliers, and the weak, i.e., information receivers, governmental measures should be introduced to solve these problems where a solution cannot be found in the market mechanism. Measures to avoid problems involving business contracts or the settlement of financial deals using telecommunications and to protect the privacy of the weak are especially important. The technologies required include man-machine technologies to improve display methods (for example, display duration and display style) and input methods of information communication equipment. In addition, the development of technological systems to improve consumers' ability to produce evidence will be required, together with new legal arrangements.

Information illiteracy describes the condition of people who are unable to operate information communication equipment due to their inability to use a keyboard, who are unaccustomed to systematic thought based on loge, or who are averse to using such equipment. These problems are likely to appear with more frequency with the wider use of such equipment. Since information literacy is considered to be the ability to effectively utilize information, its spread among the populace is an absolute necessity for the development of an advanced information-oriented society in order to counteract the current tendency for information systems to be developed for use by a small number of people who have a specific talent for handling information communication equipment.

Current development efforts are driven by the consideration of how the logic and efficiency of the equipment can be adapted to humans. The fostering of information literacy currently focuses on the understanding and judgmental faculties of humans, while the improvement of man-machine interfaces centering on input-output methods mainly deals with human physical movements. In the future, however, apart from these improvement efforts, information communication systems which presuppose human sentiments and ambiguities must be developed. Technological developments which aim at the humanization of computers will have as much importance as the question of giving priority to either keyboard or voice input. Here, technological developments to produce a quasi human thought process, as seen in the development of AI (artificial intelligence), will be crucial. The development of information communication systems which are delicate enough to talk to humans and understand human characteristics will indeed be important technical tasks to

Close the gaps originating from the progress of an advanced inform. mationotiented society.

External Economic Effects

The public communication networks which have begun try

provide. telegraph and telephone services have developed into various networks following the advancement of telecommunication technologies. As a result, the external economic effects, i.e., the social effects of information transmitted via communication networks, have become more important than ever. The facilitation of the interconnection between different networks, which has been relative lee ignored in the existing networks, is becoming increasingly important.

The facilitation of interconnection presupposes a connection
between the terminals of different machines or between different
networks. As the standardization of telecommunication technologies
is of critical importance, adjustments in technological developments
must be made. The technological tasks involved in standardization are the systematization of protocols, including, the introduction and

theorization of a standard protocol. The development of a language
to describe this protocol must then follow. Furthermore, the
preparation of the rules to allow public access to the protocol and

the sharing of development efforts should also be discussed.

The technological responses to the questions of network control

and fair charges will be important. The interconnection of different

networks will pose a technological problem of how these networks should be operated and controlled as a single entity, demanding the development of technologies which will enable the transfer of the resources owned by one network to other networks through the most appropriate connection. Since users may find it difficult to see the relationship between the

charges imposed on them and the costs involved in the case of the interconnected use of different networks, fair rules for the distribution of charges between the networks and a rational charge system should be developed.
In order to deal with problems concerning the protection of data against crime or disasters and the charge or service incompatibility of different networks, legal and organizational measures should be introduced, in addition to technological measures.

CHAPCER 14
Information Technology: Some Main Issues and Trends
Gerard K Boon

Technological supremacy in leading-edge technologies, particularly microelectronics and informatics, is being challenged by countries and cultures which are different from those which were the economic and technological leaders in the last two hundred years. Informal codes of conduct and behavioral patterns - as, for example, implied in international trade - will be affected.
Northern countries have an obligation to remain competitive and active in shifting the technological frontier. In this way the principles of plurality and mutuality can be fully adhered to. Plural
1 ity in technological change and supply of informatics prevents monopoly and economic and trade distortions, which are contradictory to a satisfactory functioning of international markets and even of democracy. Mutuality in trade advantage, and reciprocity in respect
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and goodwill in international affairs, are then maintained. Superiority of one firm or one country in one or a few aspects of technological change is not harmful to harmonious trade relations as long as there remains a balance in technological superiority between firms and countries, so that exchanges and trade can work out to mutual benefit on the basis of equality.
Technological plurality is a necessity not only for the further
growth of trade and development in the North, but also in the Indus
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ally if the number of know-how owners in the North is increased.
Access to the new technology in respect of transfer of production and use capabilities and of information processes and products is essential for all countries of both the North and the South. Information technology is an important vehicle for further development and for reducing standard-of-living gaps now prevailing between countries and between social classes within countries.

Main Issues

Main issues and trends from the point of view of the North are equally important to the South, since developing countries are greatly dependent on technological and economic events in the North. These issues are not so much technological as economic, social and political in nature. Major issues and trends in informatics are related to:
a) The technological change in microelectronics, computer, information and space technology generation, invention and innovation. We will examine the inherent structure of this process, and whether and to what extent it can be controlled, or at least influenced.
b) Access to these new technologies by various means of technology transfer, the international diffusion of the new technology, and the products made with this technology.
c) The micro and macro impact of this diffusion, economically, socially and politically.
d) Policies to accommodate points a, band c.
The significant fact is that today, technological superiority in leading-edge technologies is being challenged and in some cases overtaken by a new group of countries and cultures. This implies that existing codes of conduct and behavioral patterns (which deeply affect the four major issues mentioned) are changing and will continue to change in the future, profoundly affecting international trade practices and the corresponding international

division of labor. An adequate response to the new challenges will depend on a better understanding of the interrelated structural changes as to technology,' production locations, and exports and imports by major world area'[s] and countries. [1]C
Such an understanding is essential for preventing the collapse e[at] the present system and for avoiding conflicts in the future's
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It is generally agreed that the process of technological change - its nature, speed, depth and breadth - is a major force in determining a country's economic growth and power, which in turn must necessarily be seen in an international context. Nevertheless, the controlling parameters and conditions and their structural interaction
are not fully understood. Indeed, they are characterized by a great complexity, encompassing many factors relating to a number of scientific disciplines.
Although the process of technological change is not fully understood, micro and macro decision makers know enough to formulate strategies and policies according to certain objectives. Necessarily, these objectives are influenced by ideology, which is not a static but a very dynamic concept.
Obviously, firms or countries which are leading in the advance of technology and in its marketable applications gain in economic importance, principally through the inherent mechanisms of international trade. The terms of trade move to the advantage of the producer and seller of products containing or reflecting superior technology. If, in addition, the country of the seller implicitly or explicitly adheres to neomercantilistic (i.e., protectionist) principles, a dangerous imbalance in the global international economic order is created. Such a situation hampers the growth of the world economy and of international trade, and if uncorrected, will lead to the collapse of the international economic system. Therefore, access to and diffusion of the technological know-how on which the superior trade performance of a country largely rests is a key issue.
In order to avoid the possibility that one or a few firms in one country become a dominating force in the change of key technologies, which could imply monopoly and restrictive trading practices, an implicit code of conduct should be agreed on and respected. This code should reflect an understanding by all trading partners of the
_ mutuality and equality principles and result in more balanced inter
_ national trade, particularly in reference to high technology and its products.
An example of such an informal code is the one implied by free international trade, resulting in an international division of labor. Such a code should reflect an understanding of some inherent basic preconditions: for example, no country can only export or only import. Such a code, in order to function, should be fully based on current realities, yet it should also accommodate the wider views reflecting a global, universal interest being expressed by certain groups. These views, by means of a slow process of absorption, will eventually influence ideology, which in its turn will influence the economic behavioral patterns on which the code of conduct rests.
At any given moment, the informal code of conduct reflects
economic power realities, views of the major political leaders of the powerful countries, and the international balance of power. Infringements of the international trade order and their consequences also bear the stamp of the international balance of power.

Ideology

Economic trade theory, and social theory in general, is not neutral, but reflects the ideological and cultural realities of the time and place in which it is conceived, interpreted and amended. Therefore, theory also responds to dynamic changes occurring in the real world.
In the period since 1945, the USA has been the dominating economic and political power, and its free-enterprise and free-market ideology has shaped the international division of labor and the inherent international code of conduct. Although the conduct of the USA without doubt has been guided by pure self-interest, it can be argued that, due to its emphasis on market forces, its disdain for planning and state interference, and its emphasis on ideology at the expense of real power considerations, the USA has not fully exploited on a global scale the military, political, economic and technological supremacy which it clearly

possesses.' This argument could provide at least a partial explanation of the USA's present economic and financial difficulties. Also during this same period, the USA was engaged in a de facto peaceful but vivid ideological war with the USSR, which explains why the American economic and trade ideology has been as liberal as it has, pitted in confrontation with the ideology of its main political rival_ Ironically, the American overemphasis on the free market and the lack of state intervention came at a time when maintaining its strategic technological supremacy would have required greater governmental influence in vital sectors of the national economy. The USA's rigid adherence to its ideology has resulted in inefficiencies and rigidities similar to those experienced by its political rival.

It is precisely this faltering on the part of the USA which has given room to Japan to gain technological prominence in certain leading technologies, among them information technology. Another reason is that since 1945, Japan went through a unique process of economic and technological change. This process will not be analyzed here, but it is worth mentioning that while Japan was strongly

influenced in almost every respect by the USA, it absorbed these influences in its own way, which led to an economic behavioral pattern different not only from the one previously in force, but also from existing American and European models.

After 1945, the countries of Western Europe accomplished an unprecedented form of collaboration and even of cultural convergence. They still adhere to a unique pattern of plurality in economic, social, cultural and political matters. Although Western European economic collaboration was initiated and made possible by the USA, which greatly influenced Europe's economic and political ideology, Western Europe's ideology and conduct in both technological and economic affairs' is clearly distinct from the American style. The traditional notion that Europe generated the intellectual, scientific and technical ideas, principles and inventions, the USA took innovative action to produce and bring their products to market, and Japan pursued a follower role has changed. Not only has Japan enjoyed sustained success in absorbing both European and American research results and inventions and transforming them quickly into marketable products; Japan today is also generating more and more inventions and innovations on its own. These three areas of the globe - the USA, Western Europe and Japan - are now in fierce competition. This competition, although healthy, should not lead to the supremacy of any one of the three. Rather, these competing forces should keep each other in check, since supremacy, whether military, political or economic, may imply monopoly, domination and exploitation.

There is a possibility that, comparable to the situation emerging in the automobile industry, American, European and Japanese information technology generating firms could interconnect themselves through collaborative agreements. This could lead to a balance. However, a precondition for fair collaborative agreements and a fair balance is that the collaborating firms have something of interest to offer to each other. The main point is that industrialized and industrializing countries and areas should try to avoid becoming too dependent on technological advances in any one particular country. The basic principle of the market economies in the developed world has been the concept of plurality, in contrast to singularity and monopoly, which are in contradiction to competition and the freedom of expression, both in a material and spiritual sense.

Therefore, any code of conduct based on the free market

ideology which is so liberal that, as a paradoxical effect, it promotes monopoly and singularity in its trading partners is in contradiction to its guiding spirit and therefore self-defeating. Any such code of conduct must be open to reinterpretation and appropriate policy reformulation in order to reestablish consistency with the basic plurality principle. This observation holds for the trading interaction among the market economies of the North as well as for trade with their less industrialized partners.

Plurality

How do ideological and behavioral factors relate to current and future changes in informatics?

First of all, the northern industrialized powers - the USA, Japan, the European Economic Community and the USSR have not only a major national interest, but also an international public obligation to disseminate technological advances in information technology. Doubts about possible duplication of efforts are of minor importance and should be judged from case to case.

Each geographical area should further build up and expand its technological capability.

Each area will be served best by not falling into dependency in such a leading technology. Plurality in information technological change will imply an enrichment in technological options and combinations - new advances and differentiation which increase the potential for economic growth and international trade, which in turn pro»tote further growth in the international economy and in world development. Monopolizing forces in technological change will limit access to the newest technologies by the North, NICs and the South. The possibility of technological transfer to NICs and the South increases exponentially if the number of technology process owners in the North increases. Equally, the nature and terms of technological transfer improve and become more competitive when the number of know-how owners increases.

Hence, plurality in the supply of knowhow based on plurality in the capability to shift technological frontiers by firms and countries is an essential precondition for maintaining momentum in the growth of international trade and the development of the North and the South as a more or less integrated trading system.

Certain NICs have learned that it is easier to license new technology from some industrialized countries than from others. Joint

venture operations are more likely to be concluded with certain firms of certain countries than with other firms in other developed countries. Collaboration and technology transfer which reinforce the plurality principle should be promoted by all parties.

Mutuality of Advantage

The mutuality concept is a central principle of all international dealings, including technology transfer transactions. All agreements must be based on mutual advantage and mutual respect of the agreeing parties. No party, firm or country can flourish for long by pursuing unilateral gains. When trading parties dominate and exploit their partners, conflicts inevitably follow.

The speed of technological change has reduced the economic life of conventional technology. The new technology saves on essential inputs -labor and physical capital. These production factor savings, particularly if the relative saving of capital outweighs the saving of labor per unit of output produced, offer the developing countries even greater opportunities than they do the North, since such savings clearly favor countries where the scarcity of capital is greater than the scarcity of labor.

Still, there are other constraints related to infrastructure, skills and the nature of demand which make a faster diffusion of the new technology in the South than in the North unlikely and even undesirable. So-called leapfrogging potential arises for certain NICs, which can now catch up faster than would otherwise have been possible. But excessive leapfrogging, and an excessive speed in catching up, carries the danger of disrupting the international trading structure, leading to a protectionist backlash from trading partners.

The speed of diffusion of products containing microelectronic elements and having potential informatics applications is hampered if the plurality and mutuality principles are neglected or consistently violated.

Implications

No firm or country is served in the long run by monopolizing its knowhow. The transfer of essential technology in its specific manifestations serves both the private and public interest. Owners of technology are not expected to give it away, but to trade it by following a rational and mutually beneficial code of conduct. Similarly, countries and firms not now placed on the leading edge of technology have not only the private necessity to survive and to compete, but also an obligation to serve the public interest by entering the competitive market by means of hard work, dedication, and trade on equal terms.

Nevertheless, technological and economic matters are not the only considerations; they interact with political and cultural realities. Indeed, interdependent relations are involved. Diffusion of the new technology will be hampered to the extent that social and political conditions prevent it. Indeed, if such conditions were now fully conducive, we would be experiencing near-revolutionary changes in our societies which would create political instability and social problems. But too slow a diffusion of new technology relative to the diffusion experienced by a country's major trading partners creates other instabilities and problems of at least equal importance.

Therefore in order to avoid great imbalances and tensions, the generation, diffusion and trade relating to informatics technology should proceed according to some logic. By understanding this logic, responsible leaders can influence this system to some extent to make it more balanced.

Duality

One possible negative impact of the diffusion of information technology would be to aggravate the structural differences between developed and less developed countries or areas, or even between classes within a country. This technology, like other new technologies, has both positive and negative potential, and understanding and insight into its potential impact may help to minimize negative effects and trends and to maximize the positive ones.

Stressing the plurality and mutuality principles reduces the danger of dualism. The benefits to all humanity of the new information technology will be enhanced by creating conditions favorable to the generation and/or adoption of this technology by all countries. Plurality in the generation, adoption and diffusion of this technology, as well as of production and application capabilities, should all be fostered.

Technological advances in information technology occur largely in private enterprises. Many countries have formulated strategies and

policies to foster the process of generation and adoption of this technology which are almost exclusively geocentric to promote national or regional benefits. This is a reality, and not necessarily bad for the international system. Nevertheless, wider viewponts than those exclusively focusing on the individual firm or country interest should be expressed.

The capability to generate information technological change should be diffused and diversified not only in the North, but also in the South. Leading Third World countries - China, India and Brazil, as well as relatively smaller NICs like South Korea, Taiwan and Singapore and industrializing countries like Mexico, Colombia, Kenya and Nigeria - should be encouraged to build up suitable capabilities in informatics technology generation. While such a buildup is partially dictated by market forces and their inherent codes of conduct, the countries concerned also have some choice in the strategies and policies they pursue to improve their technology-generating capacity. There is an international public need for both the North and the South to diffuse their technology-generating capacity. Private, public, national and international interests partly converge for the simple reason that the sooner the North and the South reach comparable levels of development, the better for all. To spread information technology generating and use capacity serves that objective.

Conditions facilitating the diffusion of technology should be improved. One of the best ways to accomplish this is through free international trade. Such trade should neither be frustrated nor directly or indirectly misused. However, variations and changes in ideologies and behavioral patterns should be expected, anticipated and adequately accommodated in order to uphold the principles of plurality and mutuality and to ensure that they remain effectively in force.

Further conditions to facilitate the wider adoption of the new technology should be created. National and international specialized agencies such UNIDO, FAO and UNESCO, as well as donor agencies in the developed countries, can foster information technological adoption and diffusion in the Third World and work toward reducing and even reversing the traditional technological supremacy of the North.

Similar measures are needed to reduce disparities in the North based on differences in information technological capabilities between countries, regions or classes. Information technology has the

potential to create new employment possibilities in a very decentralized way, requiring certain skills, but modest investments. In other words, certain forms of the technology are divisible, flexible and multipurpose. Still, adoption continues to be slowed down by a gap between conditioning factors as they are and as they ought to be. Here there is a definite need for both national and international public action.

Notes

1. An example u the fact that the various agreements reached between Japan and the USA from 1945 to 1949 did not oblige Japan to contribute financially to the costs of the military protection provided by the USA, althoupJt a certain annual contribution as a percentage of Japan's GNP would have been reasonable.

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PART IV
PRIORITIES IN INTERNATIONAL COOPERATION

CHAPTER 15
International Cooperation in Inforinatic Services

Dorothy I. Riddle

Informatics is the lifeblood of the modem economy and thus an es,ential tool for development. Just as transportation networks are crucial to the distribution of raw materials and manufactured goods, telecommunications is the distribution channel of services - the growth industries worldwide. Changes in the technology linking computers with telecommunications networks are affecting every aspect of daily life and business transactions. The revolution taking place might be likened to that of the shift from oral to written language, and the ramifications are still unfolding.

There are vast differences among countries in levels of informant development. For example, in 1986, construction expenditures on telecommunications infrastructure ranged from US$ 10 million in Kenya to U$$ 14,640 million in the U.S. (see table 1). Relatively speaking, Singapore made the greatest investment (US$ 99.15 per person and US$ 257,800 per square kilometer). The Federal Republic of Germany was second in spending per person (US$ 96.53, with US$ 23,648 spent per square kilometer). Brazil, in contrast, invested only USS 6.27 per person and only USS 100 per square kilometer.

Unless country differences in informatics infrastructure are bridged in some manner, the gap between the "haves" and the "have rots" will only widen. Informatics is not an issue that can be relegated to the future. Countries not currently competitive will fall behind at a geometric rate without swift and extensive remedial measures. Not only do inefficiencies in telecommunications and data services affect the competitiveness of all facets of a nation's economy, but developing countries will lose their current business opportunities if they are not able to provide the type of service support commonly expected. For example, the integrated communications system just developed by the port of Hong Kong allows importers,
exporters, and freight forwarders to clear customs and make payments in one electronically transmitted message before the goods even reach the port.' In the increasingly competitive world of international shipping, ports without such services are suddenly much less attractive.

Expenditures on Telecommunications Construction, 1986

Country	1985 Per Capita GNP (US$)	Total Expend-tore (US$ Millions)	Expenditure per:	
			Popula-don (US$)	Square Km. (US$)

India	270	659	0.86	200
Kenya	290	11	0.51	18
Indonesia	530	641	3.95	334
Zimbabwe	680	51	6.12	131
Jamaica	940	20	9.09	1,818
Brazil	1,640	850	6.27	100
Mexico	2,080	851	10.80	431
Korea, Republic of	2,150	1,423	34.61	14.515
HongKun$_8$	6,230	121	12.48	121,4
Singupore	7,420	258	99.15	257.800
United Kivgdom	8,460	3,000.	53.10	12,245
France	9,540	4,482	81.20	8,194
Germany,Federal	10,940	5,888	9633	23,648
Japan	11,300	7,081	58.61	19.034
USA	16490	14,640	61.18	1,564

SOURCES: C. rnan and L. Isnnon, "World Telecom Spending Moves Ahead Again after
Down Period," Telephony, 24 February 1986, pp. 28-34; World Bank World Develop
man, Penny 1987 Mow vn.L r)dn,a rr,.h,;a.. 4.--- , oar

The urgency of the need for quality informatic services in developing countries cannot be underestimated. Historically, centerperiphery development theories have assumed that the center will import raw materials from the peripheral countries, giving those countries some leverage regarding development strategies. In the information age, dependency' is clearly reversed, with peripheral countries needing to import information inputs from the center. While the developed market economies, for example, may need information about developing countries, such information can be obtained in large part via remote-sensing devices or other arms-length
research techniques without the participation of the country in question.

Estimates indicate that at least 70 percent (some say as high as 85 percent) of information worldwide flows between offices within transnational corporations (TNCs). Since data networks can function effectively without the participation of developing countries, developing countries will have to act quickly, or they will find themselves not only on the periphery of, but totally excluded from, the global information network. The world is indeed becoming a global village, but that village will not necessarily include all countries. It is imperative, then, that developing countries bridge the gap and develop or acquire the essential informatic services as rapidly as possible.

Informatics can play a crucial, positive role in the economic development of rural areas, which have historically lagged behind urban centers in their access to social and business services. Informatic services - especially those using satellite links - can neutralize such locational disadvantages. For example, the Peru Rural Communications Project enables physicians at hospitals to network regularly with community health providers to diagnose and treat village patients from a distance. The University of the West Indies uses an INTELSAT link between Jamaica and Barbados to provide long-distance teaching among campuses on the islands of Jamaica, Barbados, Trinidad, St. Lucia, Dominica, and Antigua. Indonesia has developed similar services through its PALAPA satellite to nine rural communities.

Because of the capital requirements involved in creating and maintaining adequate informatics capabilities, international cooperation is crucial. The selection of the most appropriate cooperation efforts to undertake depends on an analysis of five areas: (i) types of informatic services desired, (ii) infrastrctural support, (hi) education/ training of workers, (iv) maintenance and repair, and (v) regulation and standardization (see figure 1). In each area, both public-sector and private-sector initiatives are possible, though one may be more desirable than the other.

Types of Informatic Services Desired

Developing countries can use informatic services in three major ways:

a) To generate foreign exchange earnings.
b) To protect traditional industries.
c) To modernize methods of production.

/informatics Services to Generate Foreign Exchange Earnings

Informatic services can be used in a variety of ways to generate foreign exchange earnings, the most common of which is through the leverage of lower labor costs for data processing via telecommunications links. For example, Barbados has at least five major contracts with U.S firms for offshore data entry (see table 1.). American Airlines estimates that it saves 50 percent of costs by sending data entry work to Barbados and has plans to market such data entry subcontracting to other firms.' Developing countries now providing data entry services for U.S. companies include (besides Barbados) India, Jamaica, Mexico, the People's Republic of China and the Philippines; and at least 75 U.S.-based data processing firms now have foreign bureaus.'

While turnaround time can decrease the attractiveness of offshore data processing, Universal Information Capture reports a 36-hour average using satellite communications with Caribbean countries, quite competitive with in-country processing.° As satellite communication costs drop, the threat comes not from in-country processing, but rather from nonmanual forms of data entry - e.g., bar codes read by optical scanner, optical scanner character recognition, and voice recognition technologies - and from input directly by customers. Mexico, for example, just lost a significant number of jobs in a contract for entering redeemed store coupon information due to the introduction of optically seannable bar codes on the coupons.

Computer software development is another area where lower labor costs can create a competitive advantage. India, for example, has several firms specializing in customizing business software for medium-sized firms. Again, however, technological changes can erode such a position as software designers incorporate methodology for customers to customize their own business packages. Database creation also has possibilities. While major databases have been developed in the U.S., various Latin American countries are developing specialized databases whose information can be sold on the international market.'

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It is generally agreed that the process of technological change - its nature, speed, depth and breadth - is a major force in determining a country's economic growth and power, which in turn must necessarily be seen in an international context. Nevertheless, the controlling parameters and conditions and their structural interaction are not fully understood. Indeed, they are characterized by a great complexity, encompassing many factors relating to a number of scientific disciplines.

Although the process of technological change is not fully understood, micro and macro decision makers know enough to formulate strategies and policies according to certain objectives. Necessarily, these objectives are influenced by ideology, which is not a static but a very dynamic concept.

Obviously, firms or countries which are leading in the advance of technology and in its marketable applications gain in economic importance, principally through the inherent mechanisms of international trade. The terms of trade move to the advantage of the producer and seller of products containing or reflecting superior technology. If, in addition, the country of the seller implicitly or explicitly adheres to neomercantilistic (i.e., protectionist) principles, a dangerous imbalance in the global international economic order is created. Such a situation hampers the growth of the world economy and of international trade, and if uncorrected, will lead to the collapse of the international economic system. Therefore, access to and diffusion of the technological knowhow on which the superior trade performance of a country largely rests is a key issue.

In order to avoid the possibility that one or a few firms in one country become a dominating force in the change of key technologies, which could imply monopoly and restrictive trading practices, an implicit code of conduct should be agreed on and respected. This code should reflect an understanding by all trading partners of the

_ mutuality and equality principles and result in more balanced inter

_ national trade, particularly in reference to high technology and its products.

An example of such an informal code is the one implied by free international trade, resulting in an international division of labor. Such a code should reflect an understanding of some inherent basic preconditions: for example, no country can only export or only import. Such a code, in order to function, should be fully based on current realities, yet it should also accommodate the wider views reflecting a global, universal interest being expressed by certain groups. These views, by means of a slow process of absorption, will eventually influence ideology, which in its turn will influence the economic behavioral patterns on which the code of conduct rests. At any given moment, the informal code of conduct reflects economic power realities, views of the major political leaders of the powerful countries, and the international balance of power. Infringements of the

international trade order and their consequences also bear the stamp of the international balance of power.

Ideology

Economic trade theory, and social theory in general, is not neutral, but reflects the ideological and cultural realities of the time and place in which it is conceived, interpreted and amended. Therefore, theory also responds to dynamic changes occurring in the real world.

In the period since 1945, the USA has been the dominating economic and political power, and its free-enterprise and free-market ideology has shaped the international division of labor and the inherent international code of conduct. Although the conduct of the USA without doubt has been guided by pure self-interest, it can be argued that, due to its emphasis on market forces, its disdain for planning and state interference, and its emphasis on ideology at the expense of real power considerations, the USA has not fully exploited on a global scale the military, political, economic and technological supremacy which it clearly possesses.' This argument could provide at least a partial explanation of the USA's present economic and financial difficulties. Also during this same period, the USA was engaged in a de facto peaceful but vivid ideological war with the USSR, which explains why the American economic and trade ideology has been as liberal as it has, pitted in confrontation with the ideology of its main political rival_ Ironically, the American overemphasis on the free market and the lack of state intervention came at a time when maintaining its strategic technological supremacy would have required greater governmental influence in vital sectors of the national economy. The USA's rigid adherence to its ideology has resulted in inefficiencies and rigidities similar to those experienced by its political rival.

It is precisely this faltering on the part of the USA which has given room to Japan to gain technological prominence in certain leading technologies, among them information technology. Another reason is that since 1945, Japan went through a unique process of economic and technological change. This process will not be analyzed here, but it is worth mentioning that while Japan was strongly

influenced in almost every respect by the USA, it absorbed these influences in its own way, which led to an economic behavioral pattern different not only from the one previously in force, but also from existing American and European models.

After 1945, the countries of Western Europe accomplished an unprecedented form of collaboration and even of cultural convergence. They still adhere to a unique pattern of plurality in economic, social, cultural and political matters. Although Western European economic collaboration was initiated and made possible by the USA, which greatly influenced Europe's economic and political ideology, Western Europe's ideology and conduct in both technological and economic affairs' is clearly distinct from the American style. The traditional notion that Europe generated the intellectual, scientific and technical ideas, principles and inventions, the USA took innovative action to produce and bring their products to market, and Japan pursued a follower role has changed. Not only has Japan enjoyed sustained success in absorbing both European and American research results and inventions and transforming them quickly into marketable products; Japan today is also generating more and more inventions and innovations on its own. These three areas of the globe - the USA, Western Europe and Japan - are now in fierce competition. This competition, although healthy, should not lead to the supremacy of any one of the three. Rather, these competing forces should keep each other in check, since supremacy, whether military, political or economic, may imply monopoly, domination and exploitation.

There is a possibility that, comparable to the situation emerging in the automobile industry, American, European and Japanese information technology generating firms could interconnect themselves through collaborative agreements. This could lead to a balance. However, a precondition for fair collaborative agreements and a fair balance is that the collaborating firms have something of interest to offer to each other. The main point is that industrialized and industrializing countries and areas should try to avoid becoming too dependent on technological advances in any one particular country. The basic principle of the market economies in the developed world has been the concept of plurality, in contrast to singularity and monopoly, which are in contradiction to competition and the freedom of expression, both in a material and spiritual sense.

Therefore, any code of conduct based on the free market

ideology which is so liberal that, as a paradoxical effect, it promotes monopoly and singularity in its trading partners is in contradiction to its guiding spirit and therefore self-defeating. Any such code of conduct must be open to reinterpretation and appropriate policy reformulation in order to reestablish consistency with the basic plurality principle. This observation holds for the trading interaction among the market economies of the North as well as for trade with their less industrialized partners.

Plurality

How do ideological and behavioral factors relate to current and future changes in informatics?
First of all, the northern industrialized powers - the USA, Japan, the European Economic Community and the USSR have not only a major national interest, but also an international public obligation to disseminate technological advances in information technology. Doubts about possible duplication of efforts are of minor importancy and should be judged from case to case.
Each geographical area should further build up and expand its technological capability. Each area will be served best by not falling into dependency in such a leading technology. Plurality in information technological change will imply an enrichment in technological options and combinations - new advances and differentiation which increase the potential for economic growth and international trade, which in turn pro»tote further growth in the international economy and in world development. Monopolizing forces in technological change will limit access to the newest technologies by the North, NICs and the South. The possibility of technological transfer to NICs and the South increases exponentially if the number of technology process owners in the North increases. Equally, the nature and terms of technological transfer improve and become more competitive when the number of knowhow owners increases.
Hence, plurality in the supply of knowhow based on plurality in the capability to shift technological frontiers by firms and countries is an essential precondition for maintaining momentum in the growth of international trade and the development of the North and the South as a more or less integrated trading system.
Certain NICs have learned that it is easier to license new technology from some industrialized countries than from others. Joint
venture operations are more likely to be concluded with certain firms of certain countries than with other firms in other developed countries. Collaboration and technology transfer which reinforce the plurality principle should be promoted by all parties.

Mutuality of Advantage

The mutuality concept is a central principle of all international dealings, including technology transfer transactions. All agreements must be based on mutual advantage and mutual respect of the agreeing parties. No party, firm or country can flourish for long by pursuing unilateral gains. When trading parties dominate and exploit their partners, conflicts inevitably follow.
The speed of technological change has reduced the economic life of conventional technology. The new technology saves on essential inputs -labor and physical capital. These production factor savings, particularly if the relative saving of capital outweighs the saving of labor per unit of output produced, offer the developing countries even greater opportunities than they do the North, since such savings clearly favor countries where the scarcity of capital is greater than the scarcity of labor.
Still, there are other constraints related to infrastructure, skills and the nature of demand which make a faster diffusion of the new technology in the South than in the North unlikely and even undesirable. So-called leapfrogging potential arises for certain NICs, which can now catch up faster than would otherwise have been possible. But excessive leapfrogging, and an excessive speed in catching up, carries the danger of disrupting the international trading structure, leading to a protectionist backlash from trading partners.
The speed of diffusion of products containing microelectronic elements and having potential informatics applications is hampered if the plurality and mutuality principles are neglected or consistently violated.

Implications

No firm or country is served in the long run by monopolizing its knowhow. The transfer of essential technology in its specific manifestations serves both the private and public interest. Owners of technology are not expected to give it away, but to trade it by following a rational and mutually beneficial code of conduct. Similarly, countries and firms not now placed on the leading edge of technology have not only the private necessity to survive and to compete, but also an obligation to serve the public interest by entering the competitive market by means of hard work, dedication, and trade on equal terms.

Nevertheless, technological and economic matters are not the only considerations; they interact with political and cultural realities. Indeed, interdependent relations are involved. Diffusion of the new technology will be hampered to the extent that social and political conditions prevent it. Indeed, if such conditions were now fully conducive, we would be experiencing near-revolutionary changes in our societies which would create political instability and social problems. But too slow a diffusion of new technology relative to the diffusion experienced by a country's major trading partners creates other instabilities and problems of at least equal importance.

Therefore in order to avoid great imbalances and tensions, the generation, diffusion and trade relating to informatics technology should proceed according to some logic. By understanding this logic, responsible leaders can influence this system to some extent to make it more balanced.

Duality

One possible negative impact of the diffusion of information technology would be to aggravate the structural differences between developed and less developed countries or areas, or even between classes within a country. This technology, like other new technologies, has both positive and negative potential, and understanding and insight into its potential impact may help to minimize negative effects and trends and to maximize the positive ones.

Stressing the plurality and mutuality principles reduces the danger of dualism. The benefits to all humanity of the new information technology will be enhanced by creating conditions favorable to the generation and/or adoption of this technology by all countries. Plurality in the generation, adoption and diffusion of this technology, as well as of production and application capabilities, should all be fostered.

Technological advances in information technology occur largely in private enterprises. Many countries have formulated strategies and

policies to foster the process of generation and adoption of this technology which are almost exclusively geocentric to promote national or regional benefits. This is a reality, and not necessarily bad for the international system. Nevertheless, wider viewponts than those exclusively focusing on the individual firm or country interest should be expressed.

The capability to generate information technological change should be diffused and diversified not only in the North, but also in the South. Leading Third World countries - China, India and Brazil, as well as relatively smaller NICs like South Korea, Taiwan and Singapore and industrializing countries like Mexico, Colombia, Kenya and Nigeria - should be encouraged to build up suitable capabilities in informatics technology generation. While such a buildup is partially dictated by market forces and their inherent codes of conduct, the countries concerned also have some choice in the strategies and policies they pursue to improve their technology-generating capacity. There is an international public need for both the North and the South to diffuse their technology-generating capacity. Private, public, national and international interests partly converge for the simple reason that the sooner the North and the South reach comparable levels of development, the better for all. To spread information technology generating and use capacity serves that objective.

Conditions facilitating the diffusion of technology should be improved. One of the best ways to accomplish this is through free international trade. Such trade should neither be frustrated nor directly or indirectly misused. However, variations and changes in ideologies and behavorial patterns should be expected, anticipated and adequately accommodated in order to uphold the principles of plurality and mutuality and to ensure that they remain effectively in force.

Further conditions to facilitate the wider adoption of the new technology should be created. National and international specialized agencies such UNIDO, FAO and UNESCO, as well as donor agencies in the developed countries, can foster information technological adoption and diffusion in the Third World and work toward reducing and even reversing the traditional technological supremacy of the North.

Similar measures are needed to reduce disparities in the North based on differences in information technological capabilities between countries, regions or classes. Information technology has the potential to create new employment possibilities in a very decentralized way, requiring certain skills, but modest investments. In other words, certain forms of the technology are divisible, flexible and multipurpose. Still, adoption continues to be slowed down by a gap between conditioning factors as they are and as they ought to be. Here there is a definite need for both national and international public action.

Notes

1. An example u the fact that the various agreements reached between Japan and the USA from 1945 to 1949 did not oblige Japan to contribute financially to the costs of the military protection provided by the USA, althoupJt a certain annual contribution as a percentage of Japan's GNP would have been reasonable.

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PART IV

PRIORITIES IN INTERNATIONAL COOPERATION

CHAPTER 15

International Cooperation in Inforinatic Services

Dorothy I. Riddle

Informatics is the lifeblood of the modem economy and thus an es,ential tool for development. Just as transportation networks are crucial to the distribution of raw materials and manufactured goods, telecommunications is the distribution channel of services - the growth industries worldwide. Changes in the technology linking computers with telecommunications networks are affecting every aspect of daily life and business transactions. The revolution taking place might be likened to that of the shift from oral to written language, and the ramifications are still unfolding.

There are vast differences among countries in levels of informant development. For example, in 1986, construction expenditures on telecommunications infrastructure ranged from US$ 10 million in Kenya to U$$ 14,640 million in the U.S. (see table 1). Relatively speaking, Singapore made the greatest investment (US$ 99.15 per person and US$ 257,800 per square kilometer). The Federal Republic of Germany was second in spending per person (US$ 96.53, with US$ 23,648 spent per square kilometer). Brazil, in contrast, invested only USS 6.27 per person and only USS 100 per square kilometer.

Unless country differences in informatics infrastructure are bridged in some manner, the gap between the "haves" and the "have rots" will only widen. Informatics is not an issue that can be relegated to the future. Countries not currently competitive will fall behind at a geometric rate without swift and extensive remedial measures. Not only do inefficiencies in telecommunications and data services affect the competitiveness of all facets of a nation's economy, but developing countries will lose their current business opportunities if they are not able to provide the type of service support commonly expected. For example, the integrated communications system just developed by the port of Hong Kong allows importers,

exporters, and freight forwarders to clear customs and make payments in one electronically transmitted message before the goods even reach the port.' In the increasingly competitive world of international shipping, ports without such services are suddenly much less attractive.

Expenditures on Telecommunications Construction, 1986

Country	1985 Per Capita GNP (US$)	Total Expend-tore (US$ Millions)	Expenditure per: Popula-don (US$)	Square Km. (US$)
India	270	659	0.86	200
Kenya	290	11	0.51	18
Indonesia	530	641	3.95	334
Zimbabwe	680	51	6.12	131
Jamaica	940	20	9.09	1,818
Brazil	1,640	850	6.27	100
Mexico	2,080	851	10.80	431
Korea, Republic of	2,150	1,423	34.61	14.515
HongKun$_8$	6,230	121	12.48	121,4
Singupore	7,420	258	99.15	257.800
United Kivgdom	8,460	3,000.	53.10	12,245
France	9,540	4,482	81.20	8,194
Germany,Federal	10,940	5,888	9633	23,648
Japan	11,300	7,081	58.61	19.034
USA	16490	14,640	61.18	1,564

SOURCES: C. rnan and L. Isnnon, "World Telecom Spending Moves Ahead Again after
Down Period," Telephony, 24 February 1986, pp. 28-34; World Bank World Develop
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The urgency of the need for quality informatic services in developing countries cannot be underestimated. Historically, centerperiphery development theories have assumed that the center will import raw materials from the peripheral countries, giving those countries some leverage regarding development strategies. In the information age, dependency' is clearly reversed, with peripheral countries needing to import information inputs from the center. While the developed market economies, for example, may need information about developing countries, such information can be obtained in large part via remote-sensing devices or other arms-length
research techniques without the participation of the country in question.

Estimates indicate that at least 70 percent (some say as high as 85 percent) of information worldwide flows between offices within transnational corporations (TNCs). Since data networks can function effectively without the participation of developing countries, developing countries will have to act quickly, or they will find themselves not only on the periphery of, but totally excluded from, the global information network. The world is indeed becoming a global village, but that village will not necessarily include all countries. It is imperative, then, that developing countries bridge the gap and develop or acquire the essential informatic services as rapidly as possible.

Informatics can play a crucial, positive role in the economic development of rural areas, which have historically lagged behind urban centers in their access to social and business services. Informatic services - especially those using satellite links - can neutralize such locational disadvantages. For example, the Peru Rural Communications Project enables physicians at hospitals to network regularly with community health providers to diagnose and treat village patients from a distance. The University of the West Indies uses an INTELSAT link between Jamaica and Barbados to provide long-distance teaching among campuses on the islands of Jamaica, Barbados, Trinidad, St. Lucia, Dominica, and Antigua. Indonesia has developed similar services through its PALAPA satellite to nine rural communities.

Because of the capital requirements involved in creating and maintaining adequate informatics capabilities, international cooperation is crucial. The selection of the most

appropriate cooperation efforts to undertake depends on an analysis of five areas: (i) types of informatic services desired, (ii) infrastrctural support, (hi) education/ training of workers, (iv) maintenance and repair, and (v) regulation and standardization (see figure 1). In each area, both public-sector and private-sector initiatives are possible, though one may be more desirable than the other.

Types of Informatic Services Desired

Developing countries can use informatic services in three major ways:
a) To generate foreign exchange earnings.
b) To protect traditional industries.
c) To modernize methods of production.

/informatics Services to Generate Foreign Exchange Earnings

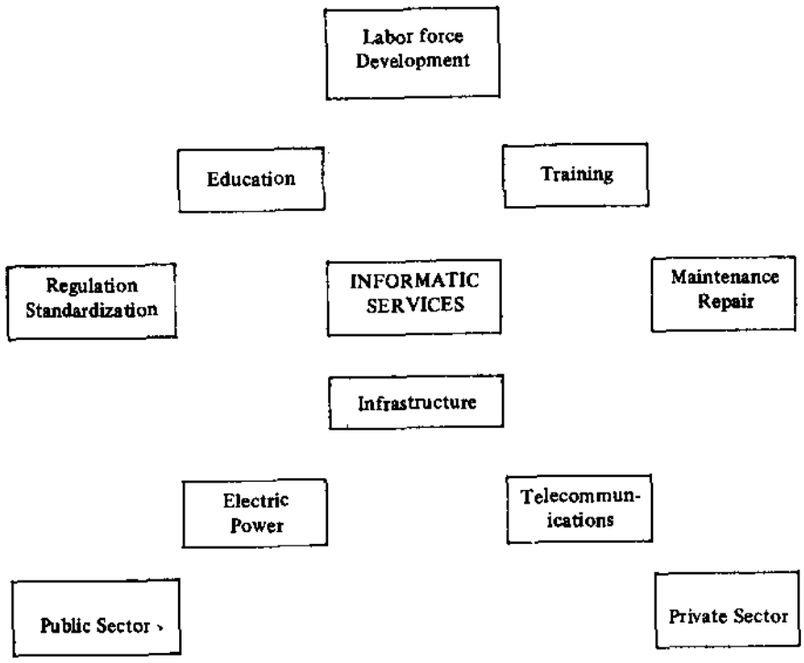
Informatic services can be used in a variety of ways to generate foreign exchange earnings, the most common of which is through the leverage of lower labor costs for data processing via telecommunications links. For example, Barbados has at least five major contracts with U.S firms for offshore data entry (see table 1.). American Airlines estimates that it saves 50 percent of costs by sending data entry work to Barbados and has plans to market such data entry subcontracting to other firms.' Developing countries now providing data entry services for U.S. companies include (besides Barbados) India, Jamaica, Mexico, the People's Republic of China and the Philippines; and at least 75 U.S.-based data processing firms now have foreign bureaus.'

While turnaround time can decrease the attractiveness of offshore data processing, Universal Information Capture reports a 36-hour average using satellite communications with Caribbean countries, quite competitive with in-country processing.° As satellite communication costs drop, the threat comes not from in-country processing, but rather from nonmanual forms of data entry - e.g., bar codes read by optical scanner, optical scanner character recognition, and voice recognition technologies - and from input directly by customers. Mexico, for example, just lost a significant number of jobs in a contract for entering redeemed store coupon information due to the introduction of optically seannable bar codes on the coupons.

Computer software development is another area where lower labor costs can create a competitive advantage. India, for example, has several firms specializing in customizing business software for medium-sized firms. Again, however, technological changes can erode such a position as software designers incorporate methodology for customers to customize their own business packages. Database creation also has possibilities. While major databases have been developed in the U.S., various Latin American countries are developing specialized databases whose information can be sold on the international market.'

FIGURE 1

Priorities for Informatics Development.



Generation and sales of remote-sensing data can be a major revenue source, as is illustrated by sales data from Landsat (see table 3). Of the remote-sensing photographic frames sold by EROS Data Center in 1982, developing countries accounted for sales of 21.4 percent, with five developing countries accounting for approximately one-tenth of the sales (see tables 4 and 5). For customers that do not have direct access to satellite-beamed data, such information can be imported and then reexported – as both India and Brazil have done. In 1980, India reexported almost 90 percent of the photographic frames purchased from Landsat, while Brazil reexported 40 percent of the computer-compatible tapes purchased from Landsat (see table 6).

TABLE 2

Data Processing in Barbados, 1983

Corporation	Work Force		Investment (US$ Thousands)	
	Number	Percent	Amount	Percent
American Airlines	288	65.0	1,000	53.4
NationalDemographks	86	19.4	400	21.3
Kline and Company	33	7.4	300	16.0
New American library	26	5.9	124	6.6
The William Byrd Press	10	2.3	50	2.7

SOURCE: Cited in K.P. Savant, Trade and Foreign Investment in Data Services (Boulder,
Colorado: WesNiew Ness, 1986), p. 83.

TABLE 3

Sales of Landsat Data to Ground Stations, 1981

Country	Sales Revenues		Frames and Scenes		
	Dollars	Percent	No, of Frames	Percent	Revenue per Frame
Developed market economies	347,312	7.2	6344	3.3	55.62
	358,715	7.4	18,315	9.7	19.59
Australia	676,143	14.0	3,587	1.9	188.50
Canada	128,021	2.6	8,488	4.5	15.08
Europe	2,663,326	55.0	130,621	69.2	20.39
Japan					
USA					
Subtotal	4,173,517	86.2	167,255	88.6	24.95

Developing countries	150,983	3.1	1,506	0.8	100.25
Argentina	353,513	7.3	8,499	4.5	41.59
Brawl	38,523	0.8	2,312	1.2	16.66
India	98,000	2.0	3,196	1.7	30.66
South Africa	26,330	0.5	6,016	3.2	4.38
Thailand					
Subtotal	667,349	13.8	21,529	11.4	31.00
Total	4,840,866	100.0	188,784	100.0	25.64

SOURCE: UNCTC, Transborder Data Flows.' Transnndonal Corporations and Remote Sensing Data (New York: United Nations, 1984), p. 10.

TABLE 4

Photographic Frunea/Computes-Compatible Tape. from EROS Data Center, 1982

Region	Frames Ordered By About Number	Percent	Frames Ordered Numbw	Percent	Tapes Ordered By Number	Percent
Developed	72,428	78.5	37,472	40.5	4,652	90.7
Eastern	68	0.1	5,518	6.0	2	0.0
DeSapingco	19,792	21	4	9,448	53.5	477	9.3
unhtiu	5,925	6.4	14,853	16.1	51	1.0
market	11,235	12.2	19,035	20.6	284	5.5
economies	1,122	1.2	1,891	8.5	117	2.3
Europe	1,510	1.6	7,663	8.3	25	0.5
Afca						
Asia						
Latin Amedce						
M)ddJeEast						
Total	92,288	100.	92,438 0	100.0'	5,131	100.0

flow SOURCE: (New You&: United UNCTC, 2MmborderOaf Undone, 1984), Flows: Tm wtatiotal pp. 18-19. Corporations and Re'notesenting

TABLE 5

Photogaphic flames and ComputetCompatlble Tapes Sold by EROS Data Center:
Top Five Developing Countries Placing Orders, 1982

	Pbotogaphi Frames		ComputerCompetibie Tape.	
	Country	Percent of World Total	Country	Percent of World Total
	Kenya	4.7	China	4.0
Cbina		4.7	Mexico	20
	Upper	16	Upper Volta	0.7

	Volta		
Iran	0.9	Indonesia	03
Indonesia	0.9	Yugos)avia	0.5
Total	12.8	Total	1.8

SOURCE: TfanabordData Flows: Corporand
UNCCC, er Twunnn'on arionr Remote
al
senatng0ata United 1984), pp.
(New York: Nations, 53-54.

TABLE 6

Use of landsat Data in India and Brazil, 1980

Type of Use	India: Frames		Bats l: Frames		Brazil: Computer Tape	
	USS	Percen t	USS	Percen t	U5$	Percent
Imported foot	1,095	8.8	152,636	45.1	65,320	46.4
Government	236	1.9	34,406	10.2	1,720	1.2
Acadenda			85,451	25.2	16,767	11.9
Industry			37,193	11.0	16	0.0
Individuals						
Subtotal	1,331	10.8	309,686	915	83,823	59.5
Imported for: Re-export	11,047	89.2	28,867	8.5	57,061	40.5
Total	12,378	100.0	338,553	100.0	140,884	100.0

SOURCE: UNCCC, 7>ansborder Data F7owa: Trans,mtfonal Corporations and Remote sensinz Data (New York: United Nations, 1984), pP. 55, 57.

Even in the telecommunications area itself, foreign exchange earnings can be generated separately from traditionally conceived point-to-point message and data services. Indonesia, of course, depends upon the leasing of excess capacity on PALAPA to countries such as Malaysia and the Philippines for foreign exchange. The Philippines, in turn, subcontracts out some of its leased space on PALAPA to earn foreign exchange.

For countries which already have good telecommunications infrastructure, such as Singapore, increasing data services sophistication can serve to attract the desired trade and foreign direct investment. Indeed, Singapore is now positioning itself as the business services center for the Pacific region in order to encourage TNCs to establish their regional headquarters there.

Informatlc Services to Protect Traditional Industries

Among developing countries without a well-developed telecommunications infrastructure or widespread computer use, there is often a belief that infonnatic services development can and should wait until more immediate basic human needs can be met. What is overlooked is the key importance of informant services in maintaining a country's present competitive position.

Many developing countries are involved in offshore manufacturing production due to its more competitive production costs. Electronic data interchange (ED!) is directly affecting cost stmt tares. For example, instructions delivered between an automobile manufacturer and a supplier can be delivered electronically in less than a day (rather than four days) and at 9 percent of the present cost.° Auto manufacturers in eight European countries have created ODETTE (Organization for Data Exchange by Tele Transmission in Europe) to develop the possibilities for cost savings via ED!. EDI can also substantially reduce other export-related costs. For example, the cost of producing an export invoice could drop from US$ 53 to US$ 0.75, a savings of close to 99 percent.'

In a related development, on-line or point-of-sale systems are revolutionizing the delivery of retail services by converting transactions from cash, checks, and credit cards to electronic tmnsfers,e Savings can cut costs to one-twentieth of their present amount. Interestingly, Hong Kong, Singapore, and Thailand are the current leaders in such "cashless shopping," underscoring the fact that developing countries are not always technology followers.'

Informatic Services and New Production Methods

Real time data services, while expensive, are rapidly increasing the efficiency, and hence the competitiveness, of businesses. For example, Garuda Indonesian Airlines' iecent switch to a computerized, networked reservations systems was an essential prerequisite for international competitive positioning.

On-line data services are updated perhaps daily and are less expensive than are real-time services, which are continuously updated.[10] They are helping to close the gap between

production sites and consumer markets in order to more effectively match products with markets. Benetton, for example, has over two thousand retail outlets connected to the major production design office so that buying trends can be monitored at the close of each business day and new products made available in less than one-third the normal production cycle. Similarly, American Airlines uses data services to analyze load factor trends and thereby develop fare structures geared to maximizing revenues on each route. Uses are wide-ranging, from tracking of accounts receivable to ensuring customer follow-up for related products.

Producer services (provided to businesses) are currently the area of most rapid growth worldwide, and data services play a crucial role in the ability of these services both to develop and to be equitably accessible." For example, fishermen can receive market pricing information via communal FM radio while still at sea," and farmers in Yemen Arab Republic can monitor market activity while still in the fields harvesting." Other producer service applications include climatic prediction, monsoon tracking and managerial support."

The surge in at-home shopping via videotex links consumer and producer without the need for physical proximity," just as twentyfour-hour electronic commodities trading eliminates the need to be present in a stock exchange. The result of such decoupling is more flexibility for both consumer and producer. As data services increase accessibility to services through increased transportability, producers are freer to relocate production sites globally as SWIFT did, for example, in order to take advantage of the lower telecommunications costs in the Netherlands. The ability to decouple production and consumption also means that the size of one's domestic market becomes less crucial, since international markets are just a call or keystroke away.

As potential customers become more comfortable with informant technologies, self-service can acquire a new dimension. More and more service firms are now asking customers to perform data entry tasks so that the managerial database remains completely current. For example, Service Merchandise (a discount showroom/ catalogue store in the U.S.) offers customers a "fast track" option of entering their requests for merchandise in computer terminals posted around the store via interactive, "user-friendly" electronic requests. Once the computer has verified that the merchandise requested is in stock and has issued the appropriate purchase order, all the internal "paperwork" is complete.

While decoupled services may appear to be more distant and less personal than face-to-face service delivery, that need not be so - especially with the technology available for interactive, on-line computer services. Database services, such as DIALOG, are only one example of the ability to customize the response to a client's request through on-line data services. Krommenacker[16] has a suggested list of the wide variety of changes in business practices resulting from telemetric technology, particularly those involving customization at a distance.

Dorothy Riddle

One of the features of informatic services is that the infonna tion they represent is not negatively affected by accessibility, i.e. within certain technological limitations, simultaneous access by age infinite number of customers is possible without diminishing this information supply. In fact, with interactive systems, the multiple use of data services may actually enhance their usefulness - a post. rive-sum game. Thus, cooperation among countries is a viable
strategy.

Infrastructural Support for Infonnatic Services

In the developed market economies, informatic services assume the existence of adequate telecommunications infrastructure as well as extensive computer networks, databases, and the ability to manipulate information on-line. For the developing countries there are many prior issues; hence, many developing-country governments characterize infornatic services as detracting from crucial development concerns.

In thinking about state-of-the-art informatic services, it is easy to begin with computef capability as the initial determining factor. However, in many developing countries there are prior issues, with the availability of dependable, constant-voltage power being the most basic. While most urban areas have electricity, electrical power is not necessarily available in rural areas. Substantial differences exist worldwide between developed and developing countries in the availability of commercial power (see table 7).

The second infrastructure issue is the availability of telephone capacity, since a growing portion of informant services are transmitted via telecommunications links. While developing countries account for over 70 percent of the world's population, they contain only 7 percent

of the world's phones." Developing countries average less than one phone for every 33 persons (in Africa, less than one phone per 100 persons), while the average in developed market economies is almost one phone for every 2 persons (see table 8).

Again, in developing countries there is often a disparity between urban and rural areas. Telephone density in urban areas typically averages 10 times that of the rest of the country, as compared with a disparity of only 1.5 times in developed market economies.[11] Iefajiy rural communities may have no conventional phone service at all, leaving up to 75 percent of the population without access to

TABLE 7

Cmumnpdon of Commercial Energy, 1983

'/n Regiot~Ceuntty	Consumption pet Cute, (Gisejoules)	Of World Total: Total Consumed (Percent)	total Needed (Percent)
Developed market economies			
Unltedstates	273	25.5	24.0
Canada	280	2.8	3.3
Japan	100	4.7	4.6
Western Europe	123	16.6	16.6
AustnBa/NZ	141	1.2	1.2
Eastern Europe	134	26.3	6.6
Developing count eke	12	2.5	3.8
Africa	18	129	14.1
Adam	31	2,2	6.3
Latin America	145	2.4	2.2
Middle East	10	0.0	0.0
Oceania			
World	53	100.0	100.0

SOURCE: World Resources institute, World Reawakes 1986 (New York: Bat, Bootee,
19861, pp. 292-3.

TABLE 8

Repeal Telephone Dktributlon,1980

Recon	Phone, pet 1001n1u6ifants

Developed market economies	44.5
Developing countries	2.8
Africa	0.8
At	1.0
Latin America	5.5
World	19.1

SOURCE: t1 Sounds, 1.J. Warlord, and B. Wdlenim, TelecommunJmpons and Econo
mic Development (Baltimore: Johns Ropkins University Re,s, 1983), pp. 4-5.

telecommunications or data services. India has tried to address the massive urban-rural gap through satellite communications linked to television receivers.[19] Malaysia is experimenting with cellular radios, though the initial investment of approximately US$ 1,000 by the customer is still a significant barrier.

In order to transmit informant services, there typically must be not only telephone and/or satellite service, but also excess capacity that can be used for data services. If inadequate capacity is already heavily used, little potential remains for developing data services capacity. Wellness reports "significant losses in efficiency incurred (in developing countries] in agriculture, transportation, commerce, banking, government, tourism, and other sectors due to the lack of or inadequacy of telecommunications services."[0] Up to 6$ percent of requests for telephone service remain unmet in some developing countries. From data presented by SAPI" on the distribution of telecommunications output, it would appear that as high as 44 percent of telecommunication services serve as intermediary input into other production processes. Inefficiencies can thus substantially increase production costs and lower product quality.

Hand in hand with telecommunications development must come availability of computer technology. Computers, even more than telephones, remain concentrated in the developed markett economies, especially the U.S. (see table 9). Indeed, one of the concerns of the developing countries is the domination of the U.S. in the informatic arena (see table 10).

Because of the initial peed to develop a dependable power supply and basic telecommunications, such development is usually the responsibility of the public sector. Indeed, the basic infrastructure does need to be undertaken by the government, if only to ensure equitable access to services and compatible technological development. Financing for telecommunications development should be obtainable from either international development agencies or from hardware suppliers, as the investment risk is relatively low and the potential for earnings generation is high.

TABLE 9

Regional Distribution of General-Purpose Computers, 1980

Share of Region Popula-lion (Percent)	World	Share of World GNP (Percent)	Installed Computer Bye		CPUs per Million Indaba-tonal	Value of Installed Base/GNP
			Units (Percent)	Value (Percent)		
Developed market economies	18.2	70.7	81.2	87.1	176	1.8
United States	5.4	24.4	34.3	42.6	248	1.3
Japan	2.8	10.5	14.7	11.4	208	1.5
Western Europe	8.4	31.3	279	20.3	131	1.3
E.C.	6.2	23.9	23.9	240	151	1.4
Other'	1.6	4.5	4.3	4.8	104	1.5
Eastern Europe	7.5	8.7	13.1	8.7	54	1.4
Developing countries	71.9	20.3	57	4.2	3	0.3
Latin America	0.0	6.0	3.3	2.3	15	0.5
Middle East	4.2	2.5	0.5	0.4	4	0.2
Africa°	7.4	9.6	0.3	0.2	2	0.1
Southeast Asia	52.3		1.6	1.3	1	0.2
World Total	100.0	100.0	100.0	100.0	39	1.4

1. Canada, Australia, South Africa.
2. Excluding South Africa.
3. Including People's Republic of (Tma.

SOURCE: K.P. Savant. Trade and Foreign Direr lenient in Data Services (Boulder:
West view, 1906). p. 23.

TABLE 10

Revenue of Computer Services Inducted in Major Counted, 1982

Country (Use Millions)	Revenues	Percent
Intestates	26,930	72.2
Japan	3,662	10.0
France	2,040	5.6
United Kingdom	1490	4.1
Germany, Fed. Rep.	1,220	3.3
Canada	956	2.6
Italy	8t8	2.2

SOURCE: K. P. Savant, Trade and Foreign Direct Investment in Data Services (Boulder:
Westview,1986), pp. 25, 26.

Countries in which basic communication services have been privatized or deregulated (e.g., Bolivia, Botswana, Colombia, Philippines, US.) have shown mixed result The most frequent problem is a leek of adequate communication service development in rural areas. Weeklies has suggested, for example:

It would make sense to develop communication centers in rural communities that combine the usual small post offices with simple voice.plusdata terminals initially providing public telephone service, telex compatible message services, and secure financial transactions. With newly available technology, this would cost about the same as a post office with an (obsolescent) telex machine ... and would be capable of adding new services at marginal cost .[2 a]

Another author cites the case of Hong Kong, which, though it has no significant rural distribution problems, "is nonetheless an excellent example of how a privately owned monopoly can function effectively under government regulation.""

Value-added services (VANS, ISDNs) and complementary services (telephone directories, bill collection, data processing), on the other hand, can easily be contracted out to, or madethe responsibility of, the private sector. Involvement of foreign firms can increase the competitiveness of offerings, including the quality and range of services available, as well as providing additional capital for telematics development.

Since TNCs are particularly vulnerable to inadequacies in telematics infrastructure, they are often willing to invest in such facilities. For example, the major foreign hotels in Beijing jointly installed a more sophisticated communications system for central Beijing in order to meet their own needs, abiding by regulatory guidelines set down by the government.

Involvement of TNCs needs to occur quickly, however, before they decide in frustration to simply bypass existing domestic systems and thus lose interest in financing the domestic infrastructure. For example, the new Swedish satellite, Mailstar (to be launched in 1990), will orbit over the poles and pass over all earth locations several times a day. The maximum delay for messages will be three hours, and communication will occur independent of local telecommunications infrastmcture."

Labor Force Skill Training for Informaac Services

Informatic services require a literate and appropriately trained work force. Of particular concern is the skill level required of data services workers. Beyond basic literacy requirements are computer literacy and a familiarity with telematic technology. It is estimated that by 1995, more than 75 percent of workers in the developed market economies will use information technology in their daily work, compared with 45 percent at the present time." In Brazil, only 27 percent of workers possessed university degrees for data processing work in 1981. However, in the lucrative and essential field of software development, 80 percent had university degrees." One might argue that the needs of data services workers for training coincide with general educational needs for citizens of the modern world; nevertheless, the fact remains that training is needed on a massive scale.

While French-speaking countries in particular have been attempting to create global data services systems in French, the most common language of use (particularly in databases) is English. Many of the former British colonies that have rejected English for nationalistic reasons may now wish to weigh such concerns against the opportunities offered by the lucrative English-based data services market. On the positive side, data translation services are rapidly becoming more sophisticated so that material in a wide range of languages can become available. Niche markets already exist in a variety of languages for appropriate software.

In order to utilize the data processing capabilities of computers, the first step is typically the automation of accounting and inventory functions. But automation assumes that a standard operating procedure exists that can be translated into a computerized process. Often, the standardization of habitual managerial and staff behavior is not a familiar process to developing country managers because of a lack of managerial training. Hence, available computer capacity is not used as effectively as possible.

While governments retain the responsibility for providing all citizens with a basic education, the private sector can be involved Constructively in the design of educational programs in order to ensure that the needed informatic skills are included. TNCs can play a very important role in training the local labor force. For example, IBM and Citibank are viewed as excellent first employers in many developing countries, since local staff, once trained, will then move on to the management of local firms. In order to stem the "brain drain" in informatics, it is crucial that training opportunities are developed in-country so that developing country nationals do not always have to go abroad for training. In-country programs are also 'St hkclyto'be tailored to the particular needs and constraints of the local !environment.

Maintenance and Repair Support for Informatics Services

A major issue in many developing countries is the lack of maintenance provided for equipment. In countries like India, for example, little value is placed on the type of future planning which enables planners to appreciate the value of spending scarce resources on maintenance. Instead, the prevailing attitude is one of "use it until it falls apart." The Bhopal tragedy, for example, may have been partly a result of cultural attitudes toward equipment maintenance. Trahming and standardized operating procedures can help to prolong refinement life and reduce capital replacement costs.

ttdQuality control must be exerted in order for data services e sent to function efficiently. Telephone connections must be

free of "noise," and computer facilities must be housed in dust-free environments -often apparent impossibilities in developing-country environments. Thus, resource investments must meet qualitative, not just quantitative, standards.

Access to parts for repair is another crucial factor in data information operations. Equipment down for repair reduces both the capacity and efficiency of data operations. Thus, a well-developed servicing and repair support mechanism is essential for success in the industry.

One means of attaining adequate levels of information infrastructural development is to enlist the aid of TNCs. For example, foreign direct investment incentives can be linked to infrastructure development requirements within the developing countries. Additionally, TNCs can be required to train local employees in management techniques.

Regulations and Standardization

One of the reasons often given by developing countries for resisting the entrance of global data service systems is the fear of losing local control over decision making. This fear is based on the fact that data services often facilitate centralization. Yet the current trend is toward distributed data processing (DDP), or decentralized data storage"

Several factors need to be considered. First, there is a cost associated with telecommunicating every piece of data back to headquarters - often unjustifiable, in an environment of cost containment. Second, even if data is transmitted back to headquarters, it is usually also available locally through the network. In actuality, data services have increased access to information by lower-level managers and thus increased the spread of power vertically throughout the organization.

Privacy and accuracy of personal data is another crucial concern that has guided regulatory action in the past. The OECD, in conjunction with corporations such as IBM, has invested considerable effort in developing appropriate guidelines.[2]'

Even with the falling prices of computers and optical fiber tech$_n$olo$_g$i$_{es}$, creating telematics infrastructure is a costly endeavor. The current trend is toward increased on-line, interactive data processing, meaning that countries will need facilities that are more advanced and cost efficient than point-to-point telephone lines. While some countries are in the position of building telematic infrastructure for the first time, others (like India) are in the more difficult position of replacing obsolete technology with digital equipment.

First and foremost, countries will need a central plan aiming toward the acquisition of compatible equipment and the provision of necessary maintenance. The People's Republic of China, for example, allowed provinces and municipalities to order communications equipment directly from providers, with the result that at least eight different no compatible systems now exist.

While the hardware imploration trend appears to be slowing, there are still significant advances being made in technologies. In many cases, this means that countries must guard against "gifts" of discounted equipment that is in fact obsolete. Actually, newer technology may be less expensive than old technology: witness the cost of fiber optics cable or microcomputers (which are becoming as powerful as minicomputers). As the hardware innovation cycle lengthens, innovation is being shifted to software, which is much less expensive to replace.

- In several countries, radio networks are being used as an interim step until modern telecommunications equipment can be installed. In Jakarta, for example, businessmen use walkie-talkies and citizen’s band radios to remain in contact when away from office or home. A number of oil companies also depend upon digital microwave radio networks"

Given the importance of telematic equipment in receiving and providing a wide range of services, countries may opt to import equipment while exporting services. Brazil, though, has not made such a decision, opting instead to develop equipment production capacity domestically. Hopefully, equipment designs will address the needs of developing countries for surge protection and relative insensitivity to environmental changes.

As more service-sector activities become globalize, access to international telematics networks will become crucial for survival. -Already, banking services are mediated by SWIFT links among over 1,600 banks worldwide, with very sparse representation at present in some developing areas. Major news agency networks worldwide dominate news reporting, and exclusion from such networks can dramatically reduce a country's visibility worldwide. In 1981, only 44 developing countries belonged to Inter Press Service, and only 25 developing countries had news agencies linked with Inter Press Service' [o]

With even Europeans concerned about the loss of competitiveness due to inadequate telematic infrastructure," assessing strategic alternatives for developing countries becomes imperative. If a developing country continues to lag behind in telematics, loss of competitiveness both for its own products and as a site for foreign direct investment is a foregone conclusion. However, the creation of adequate telematics technology can bring instant access to world markets and world distribution channels.

The most crucial priority is that of recognizing the dangers of delay in informatics development. Once developing countries accept the vital importance of informatic services and their benefits for development, public-sector and private-sector agencies need to cooperate in both national and regional strategies for informatics development.

Conclusion

Data services are revolutionizing the manner in which business and trade are conducted. Though telematics technology may be costly to install for poorer countries, such infrastructure is vital to economic survival. Data services can no longer be viewed as optional among development priorities. Overlooking the competitive positioning potential of data services can threaten the markets of the most traditional of industries.

Often-expressed fears about privacy protection and possible labor displacement have been largely addressed. In fact, many developing countries are already producing or using data services in some form, but difficulties arise from inadequate infrastructure. While no single

data services development strategy is appropriate for all countries, mobilization of private-sector resources - especially from TNCS - can be an effective means of achieving development goals in the informatics industry.

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CHAPTER 16
International Cooperation in Informatics

Ryokichi Hirono

In order to present the priorities in international cooperation in informatics as they guide the technical assistance provided by the UNDP, this paper will outline the UNDP views on major informatics issues for developing countries, review the UNDP's involvement in informatics by way of some examples, underline new trends, and finally, identify priorities or possible courses of action for the future.

Informatics for Human Development

Informatics was initially considered important for scientific calculation purposes, and later, as a component of organizational systems to be used to expedite data processing or to improve management and productivity. Computers and communications now form the basis for one of the most rapidly expanding industries in many countries. Technological developments occurring in the production and use of computers and communications and their impact on the structure of management and industries has dramatically changed the way societies are organized and the way development takes place. Informatics is no longer restricted to productive organizations, but is now spread throughout society, even in individual households.

The UNDP is aware that the major constraints faced by the developing countries are their low levels of human resource development, the quantity and quality of domestic and international information available, their limited capacity to use the information, and the lack of adequate domestic communications systems. While some developing countries have demonstrated their ability to engage in the production of both information hardware and software, developing countries are increasingly threatened by the advance of informatics as seen, for example, in the clothing industry in developed countries. Given the current high level of unemployment and underemployment of human resources, the UNDP is also cognizant of the adverse impact in the short run of the introduction of advanced informatics technologies on the utilization of available manpower. The UNDP also foresees, however, a favorable long-run impact on the economic restructuring of developing countries in response to the changing international division of labor.

Taking into account the wide range of situations faced by the developing countries, the UNDP believes that, on the whole, developing countries require technical assistance to introduce, spread and master the development of informatics in order to be ready for the coming of an information society, where the generation and use of information are essential to guide overall development and to improve the quality of individual life. The UNDP does not consider the development of informatics as a means to achieve higher productivity in developing countries, but rather as a necessary instrument for unlocking human potential and as a challenge for mankind to reach beyond today's limited horizon.

The UNDP, as a subsidiary organ of the General Assembly of the United Nations, has a central role in the U.N. system regarding the financing of technical cooperation programs in developing countries. The technical cooperation of UNDP is based on the concept of tripartite partnership between recipient governments, the UNDP and the executing agencies of the U.N. system, such as the Food and Agriculture Organization or the World Health Organization. In providing technical cooperation, the UNDP believes in the promotion of self-reliance in developing countries by establishing or strengthening national capabilities.

UNDP Support for Informatics

The total volume and distribution of UNDP resources for financing its technical assistance programmed as of September 20, 1987 were 8,484 projects with an estimated UNDP contribution of $ 4.3 billion. The main sectors by number of ongoing projects were: (i) agriculture, forestry and fisheries (1,467); (ii) industry (1,450): (iii) general development issues, policy and planning (1,385); (iv) natural resources (796); and (v) transport and communication (758). The numerical distribution of projects by region was: (i) Asia and the iii) Africa (2,622); (iii) Latin America (1,567); (iv) I); (v) Europe (428);and (vi) global and interregional JNDP projects with an informatics component (hard
ware) number 865. They are being implemented in the following tog ions: (1) Asia and the Pacific (326); (u) Africa (168); (iii) Latin America (160); (iv) Arab states (l08); and (v) Europe

(87). The main economic sectors covered by these projects are: (1) policy and planning (159); (ii) science and technology (134); (iii) industry (1 17); (iv) natural resources (116); (v) transport and communications (91); and (vi) agriculture, forestry and fisheries (62).

In the policy and planning sector, UNDP projects are designed to establish or to strengthen governmental capacities in collecting and processing data in the field of economic planning and management. These institution-building projects usually include a large component of technical expertise, which is designed to help the recipient institution to develop its own information-gathering and processing capacities. The provision of software and hardware, however, is generally limited in terms of budget. However, in the more developed developing countries, projects are usually designed to provide direct support through specific software, accompanied by the relevant hardware.

In the field of science and technology and industry, the UNDP
project portfolio exhibits the following features:

a) A large number of projects are related to agro meteorology,
hydrology and the establishment of an information sys
tem.

b) Most projects in the African region are institution-building projects, while many projects in the other regions are designed on a direct support basis.

c) Projects in the industrial sector are concentrated in Africa on the provision of assistance to institutions in charge of investment promotion. In other regions, projects covers a wide range of sub sectors and institutions with a specific purpose for the introduction of such computer applications as CAD, CAM, or design and development.

d) The hardware component is generally higher for projects related to industry, science and technology.

e) In Asia, the Pacific and Europe, assistance to specific technical research centers and direct support to public

enterprises are the most common projects. Manufacturing industries and mechanical engineering are the main sub sectors.

In the natural resources sector, many projects are related to the management of water resources, improvement of river flood warning forecasting systems and control of power systems. Direct support projects are numerous.

In the field of transport and communications, projects are mostly related to telecommunication, railways and aviation. There are no outstanding conclusions in the agricultural sector, as the sample of projects related to informatics is limited.

The UNDP's main concern in assisting developing countries in the field of informatics has been to make a cost-effective contribution to the development of specific or adapted software and to create or reinforce institutional capacity to meet the increasingly sophisticated needs of these countries. In order to meet this objective, the UNDP relies heavily on many specialized agencies of the U.N. system, as well as on private consulting firms in project formulation, implementation and evaluation.

New Trends

Looking at new country programs as well as the ongoing pro
grams in developing countries, the following trends can be identified:

a) External debt management is a new field where technical assistance in informatics is requested by many countries irrespective of the regions to which they belong or the level of development they have reached. Besides strengthening the operational capability of commercial and development banks through computerization and office management modernization, improving monitoring capability and instituting mechanisms for external debt and budget management in various government ministries and departments has become an increasingly important objective of UNDP technical assistance.

b) The information process, the strengthening of planning capabilities and the establishment of data banks continue to be important.

c) The introduction of computer applications in coal mining, the application and dissemination of CAD/CAM tech-
piques throughout industries, support to R&D activities on specific subjects, the use of computers in telematics, cybernetics and robotics, and the establishment of computerized

maintenance management systems in engineering and machinery industries have been more frequently requested. Also, the wider aphidian of informatics in the management of urban transportation, pollution control, and the upgrading of the instructional systems in training centers and educational institutions are all on the increase in UNDP-assisted projects in many developing countries.

Future Involvement

To illustrate the UNDP's future involvement in the field of informatics, three different projects can be considered as examples.

One is the development of the Computer-based Technology Experts Knowledge System (TEKSYST). Access to relevant technological information is a key to economic and social modernization. Many developing countries cannot manage this easily and seek advice through bilateral and multilateral channels, including the UNDP. Data banks help in this regard, but their effective use requires considerable experience. On-site consultants, a common method, are expensive and time-consuming. Their value can be much improved, however, if preliminary exchanges can focus the nature and level of such missions.

What is envisioned is a rapid response system to provide firstlevel information needs on a variety of technical questions arising from the planning and programming process. It is not expected that the system will replace current modes of providing technical advice. However, the underlying premise is that this approach can deal with a substantial portion of information needs and can help to refine the process of providing long-term and more expensive technical assistance.

A study will be conducted to establish the feasibility of the proposed system. The study would encompass two levels of consideration: (i) an analysis of the need/demand for this type of service in developing countries, and the UNDP's competence to participate in it; and (ii) a technical analysis of the methodology, content and procedural implications of the proposed system.

Second is the project for Computers, Informatics and Develop-
meat in Some Arabic-speaking Countries. The objectives of the project are:

a) Assessment of problems of proliferation of informatics in Arab countries. These include: (i) standardization of the coding of the Arabic alphabetic characters for storage, processing and communications; (ii) Arabic documentation of systems and applications; (iii) certification and measurement of hardware and software in the countries visited, including the level of infrastructural development, telematics, and the status of computer-related industries.

b) Assessment of the status of regional cooperation in the field of informatics and proposals for enhancing this cooperation.

c) Surveying current work in computer education and computer-aided education and recommending further support in these fields.

Finally, the program for the Progressive Establishment of the Andean Technological Information System (SALT) should promote the exchange of information among the countries of the surgeon (Bolivia, Colombia, Ecuador, Peru and Venezuela) with regard to foreign investment and the transfer of technology. SALT consists of the following three subsystems, which operate through the specialized sectoral networks of national institutions:

a) An information subsystem for foreign investment, com
posed of information networks on foreign investment and
international prices.

I,) An information subsystem on properties and use of
technologies, composed of information networks on
transfer of technology and on industrial property.

e) An information subsystem of technological knowledge
which is integrated by sectoral networks - e.g., phar
maceuticals.

Given the rapid advances of information technology and hardware, the UNDP is planning more and "tore emphasis within its technical assistance programs on human resource development with two objectives; to streamline inputs and to improve the quality of outputs. In order to strengthen national informatics capabilities in developing countries, the UNDP will be increasingly inclined to provide short-term consultancy services rather than long-term expertise. **The UNDP will also be more than ready to subcontract part**

of the project to ascertain the quality of both inputs and outputs and their timeliness. The UNDP thus needs to strengthen more than ever its working relationships with private consulting firms all over the world.

An impetus is also given under the new administration to (i) accelerating UN!)!' assistance to the private sector in developing countries to promote their economic and social development, and (ii) enabling the UNDP to expand and diversify its relationships with the private sector in developed countries so that they can provide greater technical assistance to developing countries. Consequently, in the field of informatics, private enterprises based in developed countries are now welcome to cooperate with the UN!)!' in the provision of technical assistance via funds, technical expertise, software or hardware.

CHAPTER 17
Informatics as a Management Tool
Martha B. Stone

Over the past decade, information has been gaining recognition as a key element in the development process. Certainly, researchers know that information is crucial to their work. Good research is based on collecting and organizing information about the field or problem under study, developing and carrying out the research program in question, and then ensuring that the results of this work are made available to the information pool.

Information systems which support research activities, both commercial and public sector, are designed to facilitate this information flow. The concepts of "knowledge industries" and "knowledge workers" are gaining rapid acceptance in developed countries, where statistics show that an increasing proportion of the population is involved with these activities. Developing countries are recognizing the advantages and necessity of an adequate information base for their development. In fact, some developing countries are hoping, at least in limited sectors, to pass over the industrialization stage and go directly to information-based industries. Informatics is a key ingredient in this process.

Technological developments, especially through the tools which they have engendered, have facilitated and popularized all aspects of the information cycle. These tools are a necessary response to the "information explosion" which has threatened to overwhelm potential information users, at the same time as it has held forth the promise of so many answers to so many questions. In most cases, it is the tool built out of the technology, rather than the inherent technology itself, which is of interest and relevance to information workers and users.

For most purposes, when one talks of 'information technologies," one is referring to a particular class of technology-based tools. These are the "electronic," informatics-based tools which manipulate and communicate digital information. These tools collect, process, store, retrieve and transmit the bits and bytes which represent information. In fact, these days, "information technology' and "computer technology" are sometimes taken to be synonymous. Data processing systems are now information systems. Communications is telecommunications. When one talks of information technologies, one is really talking about informatics-based tools and systems. And even if one is not directly referring to computers, they are quickly becoming an integral part of the attendant technological systems. For example, although there is still much data collection which is done without computer assistance, much of the research analysis work is done using computers, and the information is converted to digital form at some point in this process. Remote sensing applications can produce analogue media rather than digital, but digital processing and enhancement techniques are those which are becoming most important. The "technologies' which are relevant to information systems are for the most part those which interface with computers.

Identifying Developing-country Needs

Is this progression to informatics-based tools inevitable? If so, given present limitations of financial resources, skilled manpower, and infrastructure, how can they be most effectively introduced in developing countries? Although the tools arc essentially neutral in and of themselves, their application can lead to both positive and negative consequences. Some tools are better than others, how does one select? Developing countries are especially interested in issues such as: Who developed the tools? Who exercises control over them? Can the technologies be transferred? In which sectors can and should they be applied? What are the economics of the introduction of such tools? What are the social consequences?

However, even before such questions are raised and debated with regard to any particular tool or technology, another question is usually raised first: Is the tool or technology in sonic sense 'appropriate" for developing countries? The danger here is that because of circumstances in force at the moment, a particular technology or tool may be prejudged as "inappropriate" and rejected. There is a need for informed choice based on sufficient research, experimentation, and analysis. This is especially the case since often, sonic sort of manna n. fronetdr implicit reselection process is carried out by the developed countries or by agencies involved in the transfer of technology, even if they do not do so deliberately.

If one accepts that informatics-based tools are indeed relevant for many developing-country information needs, this leads immediately to a set of broader questions. How important is it to emphasize the need for national planning in the introduction and development of information technologies? Is there really a potential 'information industry" in some of the less technologically developed regions in the near future? Would such an industry include, for example, production of software packages, production of specialized hardware or general purpose microcomputers, adaptation of software or hardware to local needs, commercial database and information services, information access and facilitation services, value-added communications services?

Other important questions include: To what extent do tools produced in developed countries really need adaptation? Would it be better to emphasize the widespread introduction of many types of technologies and tools, or the limited adaptation of fewer? Is local technology development desirable and feasible? Given the variety of types of technology and possible application areas, which should receive priority? Are there any for which a small' investment now is likely to have a more immediate multiplier effect?

The Need for Information

Information workers, as well as their direct clientele (the producers and consumers of information), have their own requirements for information to enable them to carry out their work. There are, for example, various 'tools of the trade" which provide access to other information sources to help meet their clients' information needs, These include directories, union catalogues, and inventories of databases. There is, however, another important area which directly affects the tar in which information workers do their jobs and their effectiveness in doing so: the tools, methods, and technologies used by the information profession. Unfortunately, there is a major lack of appropriate, well-organized information about these, especially as they relate to informatics-based tools.

There is a wide variety of subjects covered in this area. Tools can include card catalogues, optical coincidence systems, thesauri.

and computerized database software. Methods and systems approaches include village-level information centers, integrated district level systems, decentralized and centralized networks, information repackaging and consolidation, agricultural extension, and statistical methodologies and products, such as socioeconomic indicators. Technologies include manual methods, computers, micrographics, telecommunications systems, remote sensing, and so on. However, it is especially in the area of modern information technologies and informatics that the information gap is widest in developing countries.

Information workers require information on: the "state of the art" in information methods and technologies, including trends; technologies adapted for particular circumstances or working conditions; case studies of both successful and unsuccessful information systems and approaches ;local availability, cost, and experiences with particular technologies; local policies and regulatory conditions (especially in the area of telecommunications); local sources of technical expertise; and soon. This information is required to permit informed choice in the selection of tools and technologies, to allow for effective sharing of experience and expertise in a region where resources are limited, and to encourage the development of realistic, user-oriented applications which solve real-world information problems.

The Need/or Training

An area in which training is especially important for information professionals is related to information technologies, tools, and methods - the means with which information workers do their jobs. Information workers themselves have a tremendous ongoing need for information in

numerous domains. Their training should provide them with the basic information set and the means to update it on an ongoing basis (through continuing education, access to relevant information services, etc.). This updating is especially critical with relation to the rapidly changing new information technologies.

Of course, any specific curriculum needs to be tailored to the level, needs and likely working environment of the individual in question. Do all information workers need to learn how to use microcomputers? Clearly not, but even some general introductory material to computer literacy (even without "hands-on" training)

could be of some value in the future. For advanced-level information professionals (e.g., at the postgraduate level), training in the conception, design and use of systems involving a variety of information technologies is important. The key element is to teach enough so that information professionals can make informed choices, or can effectively use technical expertise in these areas.

In addition, there is the issue of providing technical training to produce the ensemble of technical skills needed to support the information technologies themselves. This is related to the overall question of building up local information/information-technology industries and infrastructure. It seems clear that regional and cooperative approaches are needed in many cases.

One area of particular concern is the difficulty of communication between information professions and those involved with the supporting technologies - for example, between documentalists and computer systems analysts and programmers. Just as it is important that information professionals be exposed in their training to computer-based applications, so too should computer professionals be exposed to information applications (including, for example, documentary databases, text-based systems, statistical databanks, etc.).

The Need for Local Information and Informatics Industries

In many developed countries, the `information" sector is already recognized as an important one in the economy, especially if one includes activities which produce or integrate the technologies, tools, and services to support it (including, for example, computers, software, data communications, etc.). However, in some developing regions, this sector is very small and often virtually unrecognized, even as a potential vehicle for economic development. Many factors contribute to this situation - shortages of skilled personnel, training and research facilities, telecommunications and industrial infrastructure, policies, professional bodies, and so on. Furthermore, it would be unrealistic to expect major shifts into this area in the short term. Related to this is the fact that information is not often seen as a commodity of value, one that must be paid for somewhere along the way. This especially inhibits the financing of an information services sector, whether commercial or public.

It is evident that the ability to offer information services and to develop information technology skills is enhanced by a local capacity

to produce, adapt and maintain the technologies and tools. Conversely, any local industry depends on a market and a supply of skilled personnel.

A key ingredient to the ongoing success of any information project is the availability of local technical expertise. This expertise can be required for training, system analysis and design, implementation, ongoing technical support, maintenance, evaluation, and so on. The advantages are evident: familiarity with local conditions, constraints, cultural factors; local contacts; ability to work in local languages; follow-up, ongoing support, and availability to respond to queries; and (usually) a lower cost, payable in local currency. However, the local supply of persons with such expertise may be extremely limited and sometimes in great demand. In addition, the depth and breadth of experience and familiarity with the latest advances in technology may be less than those of a "foreign" expert. Note that in the above discussion, "local" expertise is taken to mean national or even regional, as opposed to that coming from a developed country.

In some of the more technologically advanced countries, the "information sector" is being viewed as one client of a potential `informatics" industry - one involving computer hardware, software and applications for a variety of uses, including public and private administration, resource management, planning, and of course information. It appears that to be successful, regional strategies and cooperation will be required (to support the training, capital, and market needs), and that the emphasis should be on software and other non-capital-intensive (but information-intensive) industries. The entry point for effective, immediate action in many developing countries appears to be applications involving

the microcomputer.
While information programs require adequate infrastructure, including local information and information technology industries, there are other related areas in which assistance can be provided: sensitization of policy makers to the importance of information as a tool for development; promotion of national policies in information and information technologies; support for the development and use of appropriate information technologies in information projects in the region; training; studies on specific needs for information sciences and informatics technologies (e.g., the types of software required in priority development disciplines); and so on. Finally, improved information services on the relevant technologies can promote greater awareness of existing gaps, and hence, opportunities for the development of products and services.

The Need for Local Experimentation

Even when specific information technologies are known in
developing countries (for example, through reading of the literature,
especially literature from developed countries), there is often a lack of local experience with the technologies. This lack of experience is often tied to other lacks: training, local expertise, maintenance, etc. In many ways, it is a vicious cycle.
Experience with a tool or technology can be gained in essentially two situations: when the object of the exercise is experimentation/testing/adaptation of the tool or technology, or when the tool or technology is simply being used to carry out some function within an information system or service. It should be noted that, in the former case, the testing should still be linked to a "real-world," user driven application, although certain experimental constraints or conditions can be imposed. In the latter case, some attention can still be placed on evaluating the "appropriateness" and success of the tool or technology in question, in both cases, user feedback and evaluation are crucial.
Adaptation refers to making changes in the tool or technology itself or in the way it is used in order to make it more "appropriate" to the user or application at hand, Thus, changes in hardware, software, language, character set, documentation, interfaces, application, or even environment can all be considered adaptations. To the extent that such work can involve major changes, novel approaches, innovative uses of the technique, or the development of new technologies and tools, this adaptation process can be considered applied research.
The reality of the situation in developing countries today, especially with regard to the newer information technologies, is that these are imported from the developed world. Without going into a debate on the desirability of this approach in the long terga, or the likelihood of a local information/information tools industry, it appears that working with imported technologies is here to stay in many developing countries for quite some time and has the potential to greatly assist with information delivery and development processes.

The Need for 'Appropriate' Tools and Technologies

In establishing and operating information systems and services, information workers make use of a variety of information tools, technologies, and methods, both manual and automated. The selection of these tools and technologies, especially at the design stage of an information system or service, usually has a major impact on the requirements for funding, personnel, infrastructure, connections to other systems, and the overall effectiveness of the activity. However, the choice of an appropriate tool or technology is often a difficult one, depending on local infrastructure, available information, experience with (and availability of) adapted, documented, and usable tools or technologies, local expertise, and standards.
But what is an "appropriate" tool or technology? Is it to be appropriate with reference to training and skills of the personnel who will use it (present or potential)? clientele for whom it will ultimately be used? institutional environment? local infrastructure? physical requirements? local support and maintenance? financial resources? functional requirements? volume and type of information to be handled? regulatory constraints? current practices of other related information services? standards? changing circumstances and conditions? Ideally, all of the above conditions apply, as well as others. Each case must be studied carefully and individually before a choice is made.

One Donor's Response: Informatics at IDRC

A wide variety of requests for assistance in meeting needs such as have been described above are communicated each year by developing countries to the International Development Research Centre (IDRC), a public corporation established by the Parliament of Canada in 1970 to stimulate and support scientific and technical research by developing countries for their own benefit. IDRC is somewhat unique among development aid agencies because it has stressed information sciences from the outset, in addition to its support for programs in agriculture, food and nutrition sciences, health sciences, and social sciences.' Within the Information Sciences Division at IDRC, programs provide support for: information systems and services within various sectors of importance to development, including socioeconomic and scientific and technical infor manor; development and distribution of a database management software package (MINISIS) and other computer-based tools; operation of the Centre Library; and research and experimentation with different information technologies, tools and methods for managing, storing and retrieving this information and delivering it to its end users.

The latter Information Sciences Division program, known as

Information Tools and Methods (ITM), provides support for research and experimentation covering a variety of technologies and disciplines, including informatics, telematics, cartography and remote sensing, micrographics and other storage technologies, and statistical systems and methods. Activities supported include; information systems, networks, and services on specific technologies and methods; technology assessment, selection, evaluation, and testing; feasibility studies and technology demonstrations; pilot projects and experiments; technology introduction and transfer; technology adaptation and development; education and training; and documentation and exchange of experience.

IDRC's Informatics Program, located within ITM, concentrates on tools to assist with the management of information for research and development planning in general, rather than those supporting strictly administrative applications. Furthermore, it supports the development, adaptation and testing of information tools which are in some sense "new" and hence add to existing knowledge (and which thus may be unfamiliar to many current users in developing countries). These are, however, often general-purpose tools, useful in different sectors and applications, and the Informatics Program encourages their application in different domains. Because the need for relevant software has been expressed so often, a great deal of attention has been given to the development of software packages to help solve some of the pressing problems of developing countries. The improvement of the supply of professional information to informatics workers has also been the focus of several activities funded by the program. Building up informatics skills is an important component of nearly every project undertaken by the Informatics Program. Some of the projects of the Informatics Program are described below.'

Informatics can provide useful tools for a variety of development applications, even (or, in some cases, especially) using low-cost microcomputer equipment. For example, several years ago

it was recognized that the increase in external debt in many developing countries had led to a need for better methods of recording, managing and analyzing information related to a country's overall borrowings. The Commonwealth Secretariat had studied the debt situation in several developing countries and had concluded that a computerized system using readily available microcomputer technology could solve many of the information problems related to debt management. In a series of projects, IDRC has supported the development and initial testing of the necessary computer software comprising such a system (called CSDRMS) and the preparation of appropriate training materials. The system is now operating in a pilot project in Sri Lanka with IDRC support, and in several other countries as well.

Statistical agencies are frequently asked for census data for small geographical areas which can be used in planning new facilities. For the most part, the agencies are not able to meet these requests. because the work required to retrieve and subsequently process the necessary data is excessive, and staff resources are limited. To help solve this problem, IDRC is supporting work at the Latin American Demographic Centre (CELADE) in Santiago, Chile, to develop a microcomputer-based software package for the creation, storage, and retrieval of small-area census information. Project participants are producing computer program documentation and user manuals in both Spanish and English and testing the software package in centers in St. Lucia and Chile.

The creation of ways to manage and consult the increasing quantity of scientific and technical information is imperative for developing countries such as Cuba. However,

there are various possible approaches which can be taken. In a technology investigation and demonstration project, the feasibility and appropriateness of decentralized microcomputer-based systems using Local Area Network technology for information management within Cuba's National Scientific and Technical Information System are being examined. This is being done by implementing pilot systems, inchtding automating periodicals management at the national and sectoral levels, and by integrating these systems into an overall system. The results will improve services to users of scientific and technical information in ministries, research institutions and universities.

Microcomputers can also assist with the training of researchers. In one project, the International Rice Research Institute (IRRI) in

the Philippines is developing an information retrieval system for training objectives and microcomputer-based instructional systems that will document and store the technical content of IRRI production courses in a modular format adaptable for dissemination in print, slide/tape, or computer-aided instruction format. These teaching media can be used interactively and individually by students, enhancing their learning and retention of the material. As well, this course material can be replicated and/or customized for use by other national rice research institutes.

Sometimes simple guidance and advice is needed for organizations about to undertake automation. In India, the Centre for Development of Instructional Technology (CENDIT) is developing a manual to provide structured, impartial guidance to research institutions and library and documentation centers on how to select and implement minicomputer and microcomputer systems. This manual will contain case studies of small-to-medium-sized institutions that have gone through, or are about to go through, the process of automating their bibliographic, cataloguing, word processing, data analysis, and other user and data management services. The manual will be distributed to libraries and small research institutions in India and to interested institutions in the region and elsewhere.

In other cases, information on techniques is what is required. For example, most work in development policy modeling is conducted at centers in the developed world, and detailed information about current findings and advances in methodology is not readily available to workers in developing regions. IDRC has supported the establishment of the Information Centre on Development Policy Modeling at the Systems Research Institute (SRI) in Pune, India. The Centre is collecting, processing and disseminating information on development policy modeling; adapting models which can be run on SRI'S minicomputer; selecting some of these models and creating transportable versions of them to run on a microcomputer; preparing user manuals for these computer applications; holding workshops to make information and training available on modeling techniques; and demonstrating the use of these techniques on a minicomputer and microcomputer.

One challenge in North African countries has been the introduction in computer systems of Arabic characters alongside Latin ones. IDRC is supporting a project to promote the interconnection of electronic messaging systems within a multilingual context. The

Centre National de I'tnformatique (CNI) will set up a bilingual (French and Arabic) message system in Tunisia using the telex network and conforming to international standards. This will lead to an exchange of information between countries in the region and will reduce constraints researchers now face.

Different languages often introduce complexity in computer processing as well. In another informatics project, IDRC is assisting the Institute of Scientific and Technical Information of China (ISTIC) in preparing a union catalogue of Chinese scientific and technical periodicals held within the institutions belonging to the ISTIC system in China - in Chinese. To accomplish thus, ISTIC is writing the required computer software and procedures and acquiring appropriate equipment for processing Chinese character information. The resulting database will lay the groundwork for Chinese participation in the International Serials Data System (ISDS).

Of course, new technologies continue to develop and require testing in circumstances appropriate to the needs of developing countries: For example, one set of developments involves the use of optical-disk technologies to store bibliographic references, pictures and even full text in a computer-accessible format. One such technology, CD-ROM (Compact Disk - Read Only Memory), is actively being developed and tested around the world, especially in con-junction with microcomputers. IDRC is supporting the testing and evaluation of CD-ROM technology for the delivery of bibliographic references within six IDRC projects and the Centre Library. An analysis is being carried out on CD-ROM's potential impact on the information

sciences field, particularly as applied within developing countries.
In a related project. IDRC is assisting the Consultative Group on International Agricultural Research (CGIAR) to investigate alternative methods of permanently preserving its publications, as well as of increasing international awareness and availability of these publications, particularly in developing countries. Project participants are collecting CGIAR scientific and technical literature; cataloguing and indexing this literature; physically preparing the materials for conversion to either microfiche or optical-disk storage; and analyzing the technological feasibility and market acceptability of using opticaldisk technology versus micrographics technology for preserving and disseminating the publications.
Finally, through the Information Sciences Division's Computer
and economic as well as technical. Developing countries are demanding relevant information upon which to base their decisions. The need for experimentation, open discussion and information dissemination has never been greater.
The international community has an important role to play in keeping the dialogue open and active between developed and developing countries, as well as among developing countries themselves. However, it is through the work carried out by developing countries themselves, at times in partnership with others in both the developing and developed world, that significant, long-term progress will be made in harnessing informatics for development.
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CHAPTER 18
International Training Pursued by NEC
Yasukuni Kotaka

The emergence of the information-intensive society is greatly affecting NEC's business and the associated need for technological training. A description of the basic philosophy applied by NEC in its technical training programs, and of the nature of the actual international programs conducted for its clients, will be followed by a description of systems applied in NEC's training, which is the source of its technological strength.
It was just ten years ago that Dr. Koji Kobayashi, now Chairman of NEC's Board, brought his campaign for a fusion of computers and communications into the United States. This "C&C" concept came to underlie all subsequent NEC activities in research and development, production, and marketing. With the dawn of the Age of Information, C&C is now finding worldwide acceptance and constitutes the foundation of the communications and information processing infrastructure now taking shape around the globe. The key element, of course, is the melding of the cores of communications and computers through digital technology, thus making possible the construction of sophisticated communications infrastructures offering greatly improved performance. At the same time, the operation and maintenance of the communications systems based on this infrastructure are requiring more and more advanced hardware and software technology. Naturally, this is generating an increasing need for related technological training.
The NEC story dates from July of 1899, when the company was founded in cooperation with Western Electric of the United States, making it Japan's first joint venture. At the time, it engaged primarily in the sale and maintenance of telephone and switching equipment manufactured on the basis of technology transfers.
Right from the beginning, NEC's management stressed "better products, better service" as the corporate watchword - one which
remains in effect today. NEC has constantly concentrated not only on quality, but also on providing the most extensive service to its customers, whether the subject is simple equipment or entire systems.

NEC's Business Activities and Training

NEC's sales have been steadily climbing and reached $ 13.1 billion in 1986, evidencing the company's strong position in the market. It has four main product fields (computers, communications, electronic devices and home appliances), with a different business division for each. NEC's overseas sales account for roughy one-third of the total. This high proportion of overseas sales underscores the importance of our international training programs for the health of the entire business. We regard the transfer of technology to and technical support for our clients as just as important as turning out high-quality systems. As a consequence, providing the best training opportunities for the client's engineers is one of NEC's top priorities. NEC's overseas business is conducted on a global scale, with clients in over 144 countries. NEC's international training is making a contribution to the technicians in these countries that goes beyond technological assistance.

Our training activities have expanded worldwide in order to maintain fast-paced growth in our international business. Essentially, these activities consist of instruction and special training for technicians, skilled workers and other personnel of our corporate clients, overseas dealers, distributors and branches. During 1985, NEC provided training amounting to 173,000 man-days. This training was carried out not only in Japan, but also at the company's own training centers and client facilities all over the world. In fact, NEC conducts more training overseas than it does within Japan.

In 1985, the total number of personnel receiving NEC training exceeded 25,000. Before 1986, programs at NEC Tokyo were attended by roughly 1,000 people annually. In 1986, attendance hit the 1,500 mark. A rough calculation on the basis of these figures shows that an average of 230 overseas trainees enter NEC'S courses in Japan every day. Typical course enrollment ranges from four to six trainees, with graduates numbering from forty to fifty per year.

Training Organization

For deliberations on matters of basic training policy, NEC formed the International Training Program Committee, composed of members of top management. The secretariat of the committee is charged with directing the NEC Education Training Center, which is part of the headquarters organization. This center also deals with company-wide problems and issues of common concern to all divisions, such as coordination of NEC's overall international training activities, their orientation, and problems involving language or basic technology. Most of the particularly specialized training courses, on the other hand, are conducted at the related product division or branch. There is close coordination between the center and the training departments at the project divisions for mutual support as needed. This system maintains the proper balance of centralization and autonomy in conducting training.

The courses at NEC-Tokyo alone involve more than 30 managers, 40 full-time teachers, and 60 supporting staff. In addition, there are 60 other instructors, as well as some 800 design or developmental technicians and specialists in the latest technology who impart skills to trainees on a part-time basis.

Training Facilities

NEC's Education Training Center contains training equipment, classrooms and other facilities that can handle 300 trainees at a time. Similarly, the training centers under the jurisdiction of the product divisions are equipped with transmission technology, microwave communications, electronic switching equipment, facsimile communications, computers and other instrumentation. Besides lecture rooms, most of these training centers also house workshops where trainees can practice skills using the latest products. The Yokohama Training Center, for instance, is located on the premises of NEC's Yokohama Plant, which contains the world's biggest microwave communications factory. This center is concerned primarily with training in microwave, satellite and UHF/VHF radio communications. The Tamagawa Plant, on the other hand, is the site of a training center concerned mainly with transmission technology. The manufacturing of electronic switching equipment and facsimiles at our Abiko Plant is reflected in its training center, where the focus is
electronic switching equipment and digital private branch exchange. Computer hardware training is based in the Nakagawara Training Center in the vicinity of the Fichu Plant.

Among the numerous NEC training centers outside Japan are a training center for electronic switching equipment in Dallas, Texas, another for computer technology in Singapore, and

still another for electronic switching equipment in Malaysia.

Training Courses

Training courses bear a close connection with projects being pursued by our clients. NEC has built an outstanding record in helping clients to draft and execute a wide variety of plans in the field of electronic information and communications.
As a consequence, NEC's training courses span a broad spectrum of fields in electronics technology, including computers, communications and industrial electronics. The courses offered range from lectures on basic theory to workshops for the practice of skills. In most cases, the course curriculum can be adjusted to the needs of individual trainees. The overall course structure is based on training modules, enabling clients to structure courses by selecting the arrangement of modules suited to their needs.

Features of NEC Training

The hallmark of NEC's training is its client-oriented approach. Naturally, the kind of training required varies widely from client to client. NEC attempts to have the courses meet all such requirements, as far as possible.
Another major advantage is the worldwide scope of the training, meaning that clients have a wider variety of training sites to choose from. At the same time, this global dimension serves to instill an international perspective in the NEC personnel conducting the training.

Future Outlook

In-house technological training could be termed the wellspring of NEC's technological capabilities. The electronics industry is the scene of fast-paced technological innovation in many fields. The
phenomenon was reflected in the findings of a survey of NEC technicians conducted in 1977. One of the questions was: "How long after hiring did you become aware of a significant gap between your own level of knowledge and the level demanded of you?" The replies indicated that this gap was appearing much earlier among employees hired in more recent years, in effect signifying that knowledge was steadily becoming outmoded more quickly.
We took these findings very seriously and eventually decided to incorporate a system of continuous technological instruction on the company premises. The result was the establishment of the NEC Institute of Technology Education in the spring of 1979.
There are three levels of courses available at the institute, equivalent to university undergraduate, master's and doctoral programs. The institute's programs are attended by over 500 technicians, with classes conducted even during working hours. Although there is some variation depending on the program, the time devoted to each class ranges from one-half to one day per week, with nearly forty sessions per year.
In addition, the respective business divisions hold classes required for their work. As this activity suggests, even the most seasoned technicians are finding it necessary to attend classes to keep abreast of the latest developments.
The same trend colors the international training conducted for our clients. Basically, as the fusion of computers and communications advances, it is becoming increasingly difficult to keep systems updated without an ongoing training program in step with the pace of technological innovation. This situation recently motivated the founding of the NEC Technical College, an institution designed for the training of operation and maintenance (O/M) personnel, instruotorn and other technicians among the employees of NECs regional branches in Japan. The college employs a communications satellite to make the same level of instruction found at headquarters available to those working in these branches. The communications satellite also offers the possibility of quality audiovisual education in every NEC store and branch in Japan without a single cable being laid.
In connection with our training programs, we are now assembling a host of data for investigations aimed at determining the ideal class size, curriculum, term and related matters.
Continued technological advances will presumably expand the areas that must be covered by the courses in the near future. This, in
turn, will spawn a need for the development of a more efficient system of training. The prospective means in such a system will undoubtedly be satellite communications and other new media;

enabling all trainees around the world to receive the best instruction.

Cone ISon

Behind NEC's international training activities lies the conviction that the bottom line in the quality of any NEC product, no matter how sophisticated, is the quality of the personnel supporting it. In all our efforts, we are constantly aware of what skills of equipment the client's O/M staff needs to keep NEC products completely serviced. Only with their help can we make our contribution to enhancing communication around the world.

APPENDICES

APPENDIX A

TOKYO STATEMENT ON THE INFORMATICS REVOLUTION

The second session of the Roundtable on the Informatics Revolution stressed that a constructive dialogue between the leading individuals from the North and the South on such a vital topic as informatics could lead to a more just and stable world order. Dramatic technological strides in the rapidly integrating fields of computers and communications are already becoming a part of the infrastructures to promote the economies of the developing countries. But the social impact of the informatics revolution, its impact on interdependence among nations, and its impact on the economic gap between the rich and the poor nations all need to be discussed, understood and planned for. Issues that need to be addressed are, in particular, international agreements to guarantee the free flow of information; the elimination of monopolies to ensure fair and free competition; and affirmation of the principle of respect for the common assets of mankind, so that the benefits of the informatics revolution may be shared by all. The challenge to the Tokyo participants was to work out the modalities for facilitating that process.

Issues and Recommendations

1. Today's .information technology (IT) may prove to be as essential to social advancement in the present century as steam, printing and electric power were in the past. The acquisition of this technology by the developing countries is thus not merely an option, but a necessity.

There are reasons to be optimistic about the relevance and potential of informatics as a supporting technology to development at large. Increasingly, examples of computer and telecommunications uses in developing countries are being reported to show how informatics has made the provision of certain services possible and of others more cost-effective. There are also examples pointing to the pitfalls.

2. The great majority of informatics uses reported so far appear to be in the areas of financial and statistical computations

and communications, as well as storing and retrieving data. But that use of informatics for management is an area which needs to bad further explored. Indeed, it is argued that many recent developmen' failures are due to systemic failures, such as the African famine o': the past few years, which could have been predicted and avoidec with the appropriate managerial tools.

3. Even though the engineering behind informatics is a moss advanced technology, the resulting tools provide a technology whose appropriateness to developing countries is now indisputable. Nevertheless, it has to be stressed that it is the appropriateness of the uses of informatics technology, and not the technology per se -and that in real development practice it is the appropriateness of a mix of technologies - which is to be considered. Furthermore, because of the rapid evolution of the technology, particularly its software corn ponent, developing countries need to guard against technological dependency and against dumping of outmoded technologies by the more rapidly advancing countries.

4. While discussing national policies regarding the acquisition, application and manufacture of informatics tools, the Roundtable reco®rized that developing countries constitute a group whose societies and economies vary widely in size, levels of education and training, levels of physical and institutional infrastructure, character and composition of economic sectors. etc. As such, the utility of informatics technology will vary from country to country. The newly industrializing countries (N ICs) are more sophisticated in the production and application of informatics technology than are the less developed countries (LDCs), but the least developed countries (LLDCs) have a long way to go to reap the benefits of this revolution.

5. Regardless of which type a country is, there are social and ethical considerations affecting the introduction, use and development of informatics. At its best. informatics could be used at the country level to promote human dignity and democracy: at its worst. it could be bent to serve only the elite, to restrict the Low of information and to suppress dissent. Internationally, informatics should be used to promote peace, protect the environment and foster international cooperation rather than to build secrecy or attain dominance.

On the other hand, there is a serious risk that such a powerful leveling tool could be one factor in slowly wiping out the cultural variety on earth Each country in order to m~Inrufn b. cultural identity even while acquiring foreign IT training and pro
ducts, needs to imitate and innovate selectively, combining the strength of traditional patterns of social organization and thought
with new strategies for economic progress and social equity.

6. For orderly, cost-effective and technologically compatible applications of informatics in a country, a broad national informatics policy is essential. Roundtable participants defined the essential elements of a national policy on informatics as (i) selecting priority sectors for the application of informatics technology; (ii) identifying infrastructural requirements for the effective application of informatics technology in these sectors; and (iii) preparing plans and working out concrete strategies to ensure that informatics will contribute to human resource building, generate employment and have positive sociocultuml consequences.

7. The Roundtable stressed that informatics is not and cannot be a sector by itself; rather, it is fundamentally a support technology to all sectors. An informatics policy is thus concerned with integration and coordination between sectors and should be based on supporting realistic goals set as part of the overall national development plan.

8. The importance of an "information policy" prior to an informatics policy is also stressed, but it is fully appreciated that this is more demanding and difficult to formulate and may not warrant a delay in developing certain aspects of an informatics policy, e.g., standards.

9. The question of "own manufacture" as opposed to "purchase" should be addressed by each country separately. In the near future, this question is likely to arise only for the larger and relatively technologically advanced countries. However, the Roundtable stressed that as far as software is concerned, each country should seek to own and command the adaptation and further development of software according to its needs. Because software development is predominantly dependent on qualified professional manpower, it could provide an opportunity for technical cooperation among developing countries (TCDC), which could both benefit economically and make important contributions to exploring the uses of informatics for development.

10. The introduction and use of informatics require institutional changes which invariably breed resistance and difficulties. An informatics policy should thus include measures to explain these
changes before they occur so that individuals will accept their new roles.

11. The implications for employment are varied and for some sectors are quite profound. For the information and office-oriented functions, informatics should be allowed to influence employment in a socially acceptable, cost-effective manner. Both policies and strategies should aim at maximizing the positive aspects (e.g., informatics is a growth area for the employment of women in certain countries) and minimizing the negative.

12. An informatics policy has to be backed up by the necessary legislation and regulations. While these are important, and ideally are a prerequisite to the wide introduction and use of informatics, they are also demanding and time-consuming to formulate. In reality, many countries have incomplete or no such legislation. The Roundtable views the exchange of experience among developing countries, including texts of legislation, as another important step toward South-South cooperation.

13. An important element of national informatics legislation is setting standards and devising rules to enforce them, including technology standards for data, software and hardware and operational standards for documentation and procedures (including security and confidentiality considerations). These standards should be clearly defined, rigorously enforced and periodically reviewed and updated.

The adoption of internationally accepted informatics standards (such as those of ISO and CCITT) are strongly recommended by the Roundtable.

14. A key impediment to the wider and speedier introduction or expansion of informatics is the inadequacy of the infrastructure in many developing countries. This ranges from inadequate

and/or unreliable electric power supply to insufficient institutional mechanisms and procedures to manage and provide services. Because communication is an integral part of informatics, an inadequate national telecommunications infrastructure is a particularly crippling handicap--and an unnecessary one, considering the fact that the technological products in this area have come down in cost and become relatively easy to acquire, install and maintain. Informatics strategies must therefore include the planned development and operation of a nationwide telecommunications network.

15. As another Roundtable on human development stressed,
human beings are both the means and the end of development. This is never more so than in regard to informatics, since software, which depends entirely on human beings for its development, constitutes almost 80 percent of all informatics technology. Top priority should therefore be given to the education and training of informatics professionals. This training should be purposeful, that is, tied to specific goals, jobs and tasks to be carried out; and it should be given with equipment and in an environment comparable to the professionals' eventual work environment and milieu. Training materials, adapted as appropriate, should be freely exchanged and shared to facilitate human resource development. Full advantage should be taken of training offered by the informatics industry in conjunction with the purchase of equipment, and such training should be dovetailed with other national and international tanining programs.

16. The predominance of Latin-based languages, particularly English, in the present-day informatics market has often proved to be a key impediment in the timely use and development of informatics by non-English-speaking countries.. Many institutions have found it more practical to develop software in their own languages than to seek translations of existing products. The development of informatics software and documentation should allow for their easy adaptation and translation into other languages.

17. Informatics can contribute greatly to international cooperation. For example, information networks could be enriched immeasurably by increases in the number of users, the variety of uses and the diversity of information sources. International accessibility to such a network would furthet increase its potential. Areas that are particularly promising candidates for more international cooperation are:

a) Building telecommunications infrastructure.

b) Developing domestic capability in producing software
and maintaining hardware.

c) Disseminating information on new IT, standards and uses. d) Helping LDCs to gain increased access to informatics
technology.

e) Assisting in training programs.

I8. There are other issues with respect to international co
operation in informatics which need to be recognized:

a) National needs and priorities should determine the form
and timing of international cooperation inputs.

b) International cooperation is not a substitute for thee development of self-reliance, but a facilitation of it.

c) The modalities of international cooperation are as important as the substantive cooperation.

d) Whereas the international coordination of informatics uses and development in specific sectors falls within the purview of the international organization responsible for such a sector (e.g., WHO for health), there is an apparent institutional gap in the coordination of informatics policies within and among nations which needs the urgent attention of the international community if all countries are to benefit from this revolution.

APPENDIX A

APPENDIX B
PARTICIPANTS AND CONTRIBUTORS

/All participants attended in their personal capacities. Participants' affiliations given here are those at the time of the meetingarrd not necessarily their present affiliations. An asterisk (*) after a name indicates a contributor to this volume. A double asterisk(**) indicates a contributor win could not attend the meeting,/

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APPENDIX C
NORTH SOUTH ROUNDTABLE

The North South Roundtable, established in 1978 under the auspices of the Society for International Development, is an independent intellectual forum in which academics, researchers and policy makers from around the world come together to discuss global development issues. The Roundtable brings together experts from every continent in many fields, all sharing a commitment to orderly progress in human affairs, for the advancement of a constructive dialogue between North and South, developed and developing, rich and poor nations, in search of a more just and stable world order. In its various sessions the North South Roundtable seeks to identify and analyze the most significant issues and to develop policy proposals in the mutual interest of North and South. The ideas evolved in the Roundtable process are disseminated to the general public, national decision makers and other international organizations through Roundtable publications and through direct briefings.

NSRT activities are funded by governments, international organizations and foundations; its policies are determined by a Steering Committee.

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APPENDIX D

NORTH SOUTH ROUNDTABLE PUBLICATIONS

Books (paperbound)

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